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The AUTOMOBILE

Spiral Bevel Calculations

Helical Bevel Gear Bearing Loads and Tooth Pressures Obtained by Formulæ—A Study of the Radical and Thrust Loads Produced by Helical Bevel Sets, Including Those of the Spiral Type, and the Development of Charts Facilitating Solution of Problems

By A. L. Nelson

THE object of this article is to study the radial and thrust loads produced by helical bevel gear sets including those of the spiral type, and to develop charts for the easy solution of such problems.

Bevel gears are widely used in many classes of work. Perhaps the most exacting and severest service demanded of bevel gears is that of the automobile rear axle drive gears. These gears are made of alloy steels which, for the sake of lightness, are designed to work under very high stresses. This in turn means relatively small pitch diameters and correspondingly heavy bearing loads. The bearing loads are still further increased and high thrust loads added by cutting the gear teeth at an angle of from 15° to 35° with the pitch cone element. This type of gear is now used almost universally to obtain the degree of quietness imperative in acceptable automobile design.

Equations Based on Helical Bevel Type

The equations to be derived in this discussion, for the sake of simplicity, will be based primarily on the type of helical bevel gears cut on generating gear planers. However, gears of the Gleason spiral type, which have teeth that are curved lengthwise on the arc of a circle, may be treated as though the teeth were straight and the angle of the tooth with the pitch cone element taken as the tangent of the tooth at the center of the resultant tooth pressure.

This type of gear is of greatest importance, for the method of manufacture is such as to permit quantity production at a cost so low that they are now used extensively even for machine-tool machinery. For the latter class of work the gears are often run with shaft angles other than 90°; hence the formulæ will be derived for the general case of shafts at any angle.

Condition of the Problem

Fig. 1 shows the resultant tooth load diagram for a forward drive right hand (R.H.) helical gear, and Fig. 2 the mating left hand (L.H) pinion. The dimensions of the gears as required are shown in the figures.

Let T = the pinion torque in pound-inches.

$P = \frac{T}{r_1}$ = the vertical component of the resultant tooth pressure in pounds.

ϕ = the tooth angle with the pitch cone element.

θ = the tooth pressure angle.

$A = \frac{\tan \theta}{\cos \phi}$, and

$S = \tan \phi$ which are constants for given values of θ and ϕ.

$D_1 = \frac{1}{2}$ pitch diameter of the pinion in inches.

$D_2 = \frac{1}{2}$ pitch diameter of the gear in inches.

R_2 = the pitch cone radius.

f = the tooth length.

$R_1 = R_2 - f$

Kf = the distance from the large end of the tooth to the center of the resultant normal tooth pressure.

β = the center angle of the gear.

$\alpha = 90° - \beta$

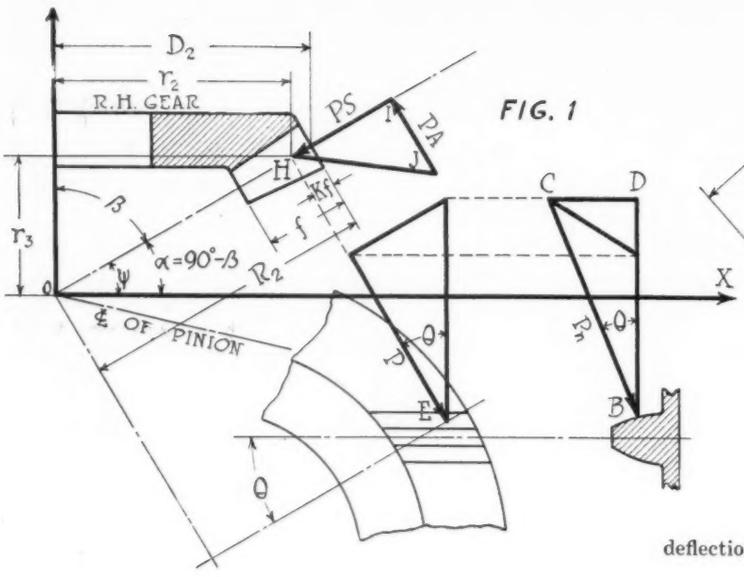


FIG. 1

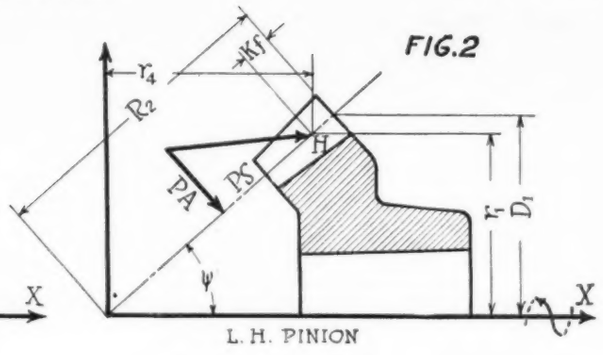


FIG. 2

Fig. 1 and Fig. 2—Diagrams explaining symbols used in calculating bevel reactions

ψ = the center angle of the pinion (= a with shafts at 90°).

r_4 and r_1 of the pinion are x and y co-ordinates of the point of application of P, having the apex of the pitch cone as the origin, while r_2 and r_3 are the co-ordinates of P for the gear.

Application of Resultant Tooth Pressure (Kf)

For the purpose of determining Kf, Fig. 3 shows a bevel gear tooth whose apex is at O. Fig. 4 shows an end view of the tooth with the normal tooth load at the outer edge of the tooth intersecting the tooth center line at B at a distance h_2 (at large end of the tooth) above the weakest section, whose thickness is t_2 (as determined by Lewis' parabola method).

In Fig. 3 is shown an elementary slice of the tooth of dx thickness and at a distance x from O, loaded with an elementary force dp. It follows from the figure that its height $h = \frac{h_2}{R_2}x$ and its width $t = \frac{t_2}{R_2}x$. since the elementary section is a very short cantilever beam, it is necessary to take into account the deflection due to shear as well as that due to ordinary flexure in what is to follow. Each case will be treated separately, taking up the case of flexure alone first.

Let S be the flexure unit stress at the weakest section (width t and thickness dx) and Δ the deflection at the point where the line of action of dp intersects the center line of the tooth. Since all the elements of the tooth form intersect at the pitch cone apex it is assumed that this is also the case when the tooth is loaded. This assumption will obtain very closely if the gear and pinion shafts are designed properly, that is, so that the deflection of the shafts will have a tendency to keep the gear and pinion in their theoretical alignment. The latter is a point in design well worth striving for in order to obtain quiet and uniformly wearing gear pairs. From the above assumption it follows Δ is proportional to x, or

$$\Delta = C_1 x \qquad (1)$$

(The letter C will be used with subscripts to indicate various constants required.)

For a cantilever beam of uniform section and of constant width t the deflection becomes—

$$\Delta^1 = \frac{\left(\frac{h_2}{R_2}x\right)^3 dp}{3EI} = \frac{\left(\frac{h_2}{R_2}\right)^3 x^3\, dp}{3E\frac{1}{12}\left(\frac{t_2}{R_2}\right)^3 x^3 dx} = C_2\frac{dp}{dx}$$

where E = the modulus of elasticity of the material and I = the moment of inertia of the elementary section.

From the fact that all of the elementary sections of the tooth are similar, it follows that the actual tooth deflection is proportional to Δ^1, therefore

$$\Delta = C_3\Delta^1 = C_3C_2\frac{dp}{dx} \qquad (2)$$

From (1) and (2)

$$\frac{dp}{dx} = \frac{C_1}{C_2C_3}x = C_4x \qquad (3)$$

Equating the bending moment to the moment of resistance

$$\frac{h_2}{R_2}x\,dp = S\,\frac{1}{6}\left(\frac{t_2}{R_2}\right)^2 x^2\,dx \text{ whence}$$

$$\frac{dp}{dx} = \frac{St^2{}_2x}{6R_2h_2} = C_5Sx \qquad (4)$$

From (3) and (4)

$$S = \frac{C_4}{C_5} = \text{constant.}$$

Now let P be the resultant of the Σdp at a distance x_0 from O. Taking moments about O by the aid of (4) and from the

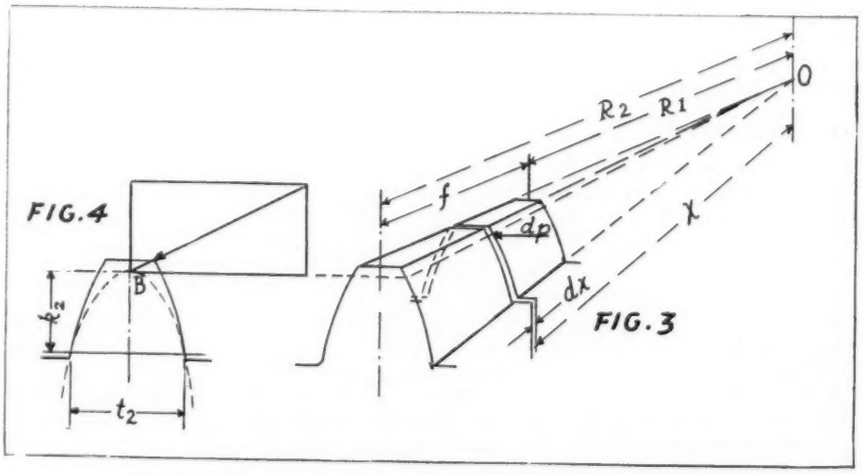


Fig. 3 and Fig. 4—Symbols representing proportions of bevel teeth

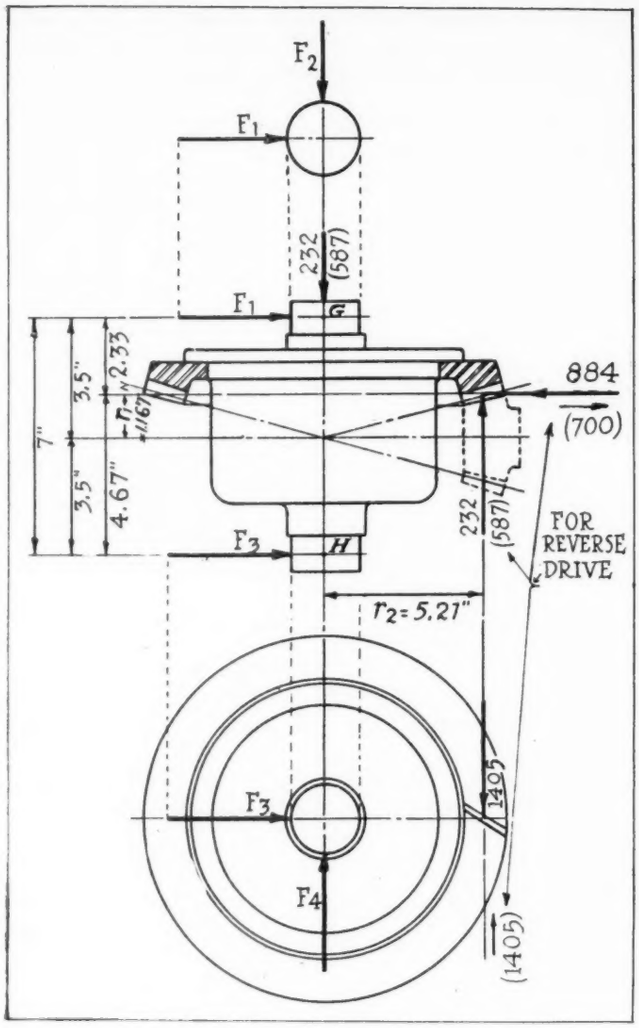


Fig. 8—Actual loads in assumed case

fact that S = constant, it may be taken outside of the integral sign, then it follows that

$$P x_o = \int_{R_1}^{R_2} x dp = C_p S \int_{R_1}^{R_2} x^2 dx = C_2 S . \frac{1}{3} . (R^3_2 - R^3_1) \qquad (5)$$

Also from (4)

$$P = C_p S \int_{R_1}^{R_2} x dx = C_2 S . \frac{1}{2} . (R^2_2 - R^2_1) \qquad (6)$$

Substituting P of (6) in (5)

$$x_o = \frac{2}{3}\left(\frac{R^3_2 - R^3_1}{R^2_2 - R^2_1}\right) \qquad (7)$$

The next step is to determine the location of P, considering the shear deflection alone. Let G be the shearing modulus of elasticity. Then for a cantilever beam of length l, unit shearing stress S_s, and unit detrusion e

$$G = \frac{S_s}{e} = \frac{S_s dl}{d\Delta'}$$

$$\therefore \Delta' = \int_o^l \frac{S_s dl}{G} = \frac{S_s l}{G}$$

As before for an elementary tooth section

$$\Delta = C_s \Delta' = \frac{C_s S_s}{G} \frac{h_2}{R_2} x \qquad (8)$$

where S_s is the unit shearing stress at the root of the tooth.

It follows from (1) and (8)

$$S_s = \frac{C_1 G R_2}{C_s h_2} = \text{constant}$$

Equating the shear to the shearing resistance

$$dp = \frac{t_2}{R_2} x S_s dx$$

$$\therefore \frac{dp}{dx} = C_7 x \qquad (9)$$

Now since equation (9) is of the same form as (4) and since S_s = a constant it follows that x_o for shear is the same as x_o for flexure. From Fig. 1

$$x_o = R_2 - Kf$$

$$\therefore K = \frac{R_2 - x_o}{f} = \frac{R_2 - \frac{2}{3}\left(\frac{R^3_2 - R^3_1}{R^2_2 - R^2_1}\right)}{R_2 - R_1} \qquad (10)$$

To simplify the work of finding the value of K for any given case, Fig. 5 is drawn with K as ordinates and $\frac{R_2}{f}$ as abscissa. The values of K were calculated corresponding to the ratio $\frac{R_2}{f}$ by taking $f = 1$, then $R_2 - R_1 = 1$ and

$$K = R_2 - \frac{2}{3}\frac{R^3_2 - (R_2 - 1)^3}{(2R_2 - 1)} \text{ (for } f = 1) \qquad (11)$$

Now that the location of P is determined the force analysis will be considered.

Force Analysis of Resultant Tooth Pressure

For the force analysis of the resultant tooth pressure friction will be neglected, since it is small, due to the rolling nature of the tooth contact. In Fig. 1 is shown the force diagram for forward drive R.H. helical type bevel gear with the pinion driving. BC is the normal resultant tooth pressure. This pressure is resolved into three components, EG is the vertical component, HI the component acting along the element of the pitch cone, and JI the component acting perpendicular to the pitch cone element. From the figure it follows that the normal resultant tooth pressure

$$P_n = \frac{P}{\cos\Theta \cos\phi} \qquad (12)$$

Also from the figure $HI = P \tan\phi = PS$, where $S = \tan\phi$ and $JI = CD = P_n \sin\Theta = \frac{P \sin\Theta}{\cos\Theta \cos\phi} = P \frac{\tan\Theta}{\cos\phi} = PA$,

$$\text{where } A = \frac{\tan\Theta}{\cos\phi}$$

There are four cases of conditions to be considered. In each case the pinion will be considered as the driver. Clockwise rotation viewing the pinion from the positive end of the X axis will be called the forward drive. The two components of forces in the plane of the gear axes will be broken up into F_x and F_y, that is, the summation of the forces along the X and Y axes respectively.

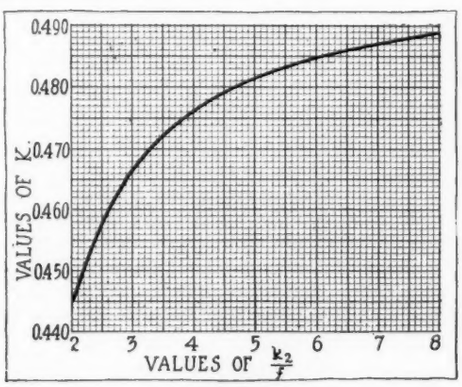


Fig. 5

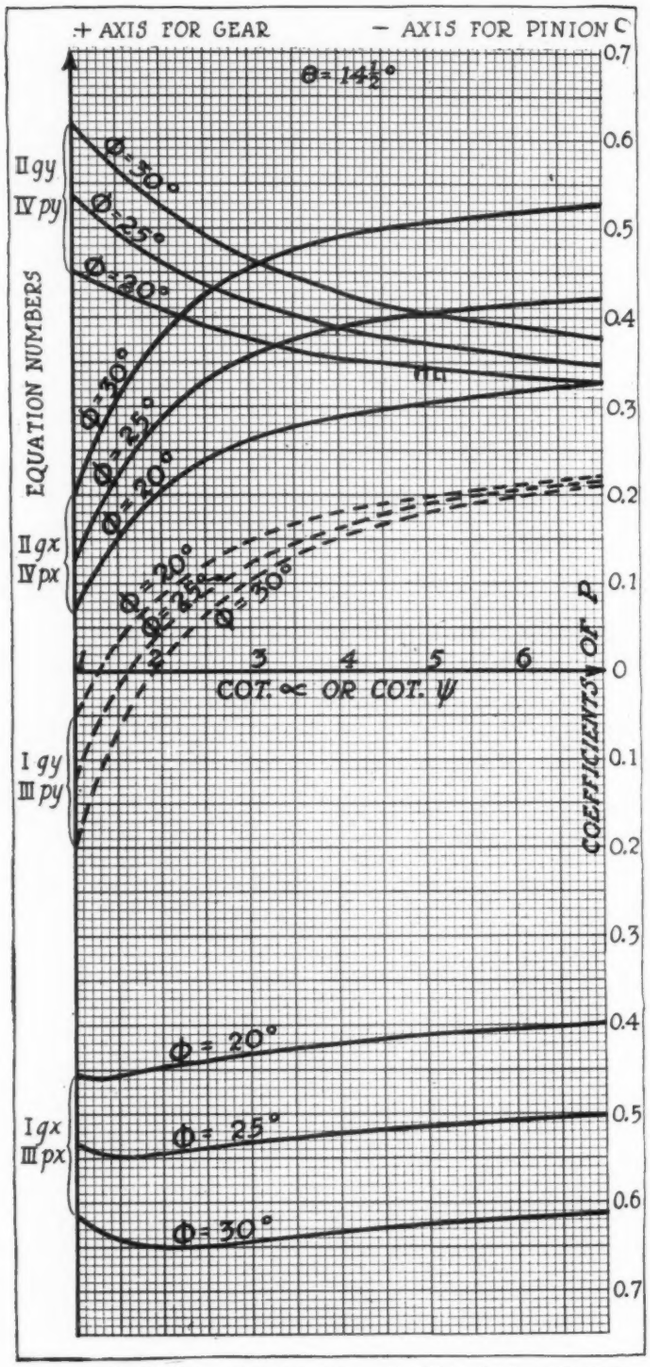


Fig. 6—Coefficients of P for gear and pinion having pressure angle of 14½

Case I. Forward drive R.H. helical gear or reverse drive L.H.

$$F_x = -P\ (A \sin\alpha + S\cos\alpha) \qquad (I_{gx})$$
$$F_y = P\ (A\cos\alpha - S\sin\alpha) \qquad (I_{gy})$$

(The subscripts of the equation numbers may be interpreted as follows: g refers to the gear and x to the X axis, while y refers to the Y axis. Later p will be used to denote the equations for the pinion.)

Reversing the helix to L.H. and also reversing the drive does not change the equations. However, if only the drive is reversed, the component along the element of the cone reverses, while that perpendicular to the element does not reverse. Hence the equations for this case are as follows:

Case II. For forward drive L.H. helical gear or reverse drive R.H.

$$F_x = P\ (-A \sin\alpha + S\cos\alpha) \qquad (II_{gx})$$
$$F_y = P\ (A\cos\alpha + S\sin\alpha) \qquad (II_{gy})$$

In like manner the equations for the pinion become as follows:

Case III. For forward drive L.H. hellical pinion or reverse drive R.H. (See Fig. 2.)

$$F_x = P\ (A \sin\psi + S\cos\psi) \qquad (III_{px})$$
$$F_y = -P\ (A\cos\psi - S\sin\psi) \qquad (III_{py})$$

Case IV. For forward drive R.H. helical pinion or reverse drive L.H.

$$F_x = -P\ (-A \sin\psi + S\cos\psi) \qquad (IV_{px})$$
$$F_y = -P\ (A\cos\psi + S\sin\psi) \qquad (IV_{py})$$

When the axes of the gear and pinion make an angle of 90°, $\psi = \alpha$ and the equations of cases III and IV become the same as for cases I and II except opposite in sign.

Graphical Solution for F_x and F_y

It will be observed from the above equations that they are all written so that the second factor is a coefficient of P. Furthermore, A and S depend only on the angles Θ and ϕ, while α and ψ depend on the ratios $\frac{r_3}{r_2}$ and $\frac{r_1}{r_4}$ respectively. General graphical solutions for the equations may then be obtained by plotting two sets of curves as given in Figs. 6 and 7 with the coefficients of P as ordinates and the cot α of the gear or cot ψ of the pinion, as abscissa. Fig. 6 gives the coefficients of P for the gear and pinion having a tooth pressure angle (Θ) of 14½°, while Fig. 7 gives those for 20°. Since the tooth angle with the pitch cone element (ϕ) generally varies from 15° to 35°, three sets of curves in each figure are given with the values of (ϕ) taken 20°, 25° and 30°. For intermediate values of ϕ interpolate between the curves. For gears with values of Θ between 14½° and 20° interpolate between the values given by Figs. 6 and 7.

Since the equations for the pinion are opposite in sign to those of the gear, the positive ordinate is taken as negative for the pinion as indicated in Figs. 6 and 7 in the upper left-hand corner.

Verification of Calculated Results.

The following table is given as a comparison of average test and calculated coefficients of P. These pinion thrust tests were made by Gleason Works and published by *Machinery*, April, 1914.

Test Number	Gear Type	Number of Teeth in Gear and Pinion	Tooth Angle with Pitch Cone Element ϕ	Tooth Pressure Angle θ	% of Tooth Load $(P = \frac{T}{r_1})$			
					Thrust on Pinion Forward Drive		Thrust on Pinion Reverse Drive	
					Observed	Calculated	Observed	Calculated
1	Plain Bevel	53–15	0°	14½°	7.34	7.06	7.62	7.06
2	"Spiral Bevel"	53–15	31°21′	14½°	−49.5	−50.3	73.8	66.9
3	"Spiral Bevel"	53–14	19°45′	14½°	−28.7	−28.7	45.0	45.6
4	"Shew Bevel"	57–18	23°46′	14½°	−30.5	−33.5	50.8	50.5

The above pinions are all R.H. In each case the observed average thrust in per cent of the tooth load was taken from a large number of trials. The calculated values agree quite closely with the test values. This fact gives an added as-

surance to the dependability of the formulas as derived in this paper.

Determining the Magnitude of P

Having determined the coefficients of P, the next step is to determine the magnitude of P. First find r_1 and dividing the torque of the pinion by r_1 gives P. From Figs. 2 and 3 it follows that

$$R_2 = \frac{D_1}{\sin\psi} = \frac{D_2}{\cos\alpha} \quad (13)$$

$$r_1 = (R_2 - Kf)\sin\psi \quad (14)$$

$$r_4 = (R_2 - Kf)\cos\psi \quad (15)$$

In like manner from Fig. 1

$$r_2 = (R_2 - Kf)\cos\alpha \quad (16)$$

$$r_3 = (R_2 - Kf)\sin\alpha \quad (17)$$

In case of shafts making 90° with each other $\alpha = \psi$ and then $r_1 = r_3$ and $r_4 = r_2$.

Shaft Bearing Loads

The bearing reactions may be found after having determined the resultant tooth pressure P, F_x and F_y. The bearing reactions will depend on how the bearings are located in reference to the gears. The method of finding the bearing reactions will be illustrated by a numerical problem for forward and reverse drive. The following data are taken from a set of Gleason spiral type automobile differential drive gears:

Pitch of teeth = 5

Number of teeth in gear = 58, in pinion = 13

$\beta = 77° 22'$

$\alpha = \psi = 12° 38'$

$\Theta = 14\frac{1}{2}°$

$\phi = 30°$ Gear R.H.

$f = 1.25$ in.

$$D_1 = \frac{13}{2 \times 5} = 1.30 \text{ in.}$$

$$D_2 = \frac{58}{2 \times 5} = 5.80 \text{ in.}$$

$\cot\alpha = 4.461 =$ (speed ratio since $\alpha = \psi$)

$$R_2 = \frac{D_2}{\cos\alpha} = \frac{5.80}{0.9758} = 5.94 \text{ in.}$$

$\frac{R_2}{f} = \frac{5.94}{1.26} = 4.76$, referring this ratio to Fig. 5 it follows that $K = 0.48$ and $Kf = 0.48 \times 1.25 = 0.60$ in.

$r_1 = (R_2 - Kf)\sin\alpha = (5.94 - 0.60)\ 0.2187 = 1.167$ in.

$T = 1640$ lb.-in. max. motor torque (from test).

$$P = \frac{T}{r_1} = \frac{1640}{1.167} = 1405 \text{ lb. on direct drive.}$$

$r_2 = (R_2 - Kf)\cos\alpha = (5.94 - 0.60)\ 0.9758 = 5.21$ in.

Since the gear is R.H the forward drive comes under case I and the reverse drive under case II. Referring $\cot\alpha = 4.46$ to Fig. 6, it follows for:—

Case I,

$F_x = 1405\ (-0.629) = -884$ lb.

$F_y = 1405\ (+0.165) = +232$ lb.

Case II,

$F_x = 1405\ (+0.498) = +700$ lb.

$F_y = 1405\ (+0.418) = +587$ lb.

The gear is mounted on two Timkin roller bearings 3½ in. each side of the pitch cone apex, as shown in Fig. 8. Fig. 8 also shows the free body diagram for forward drive. P, F_x and F_y are shown acting on the gear tooth engaging the pinion. The forces for reverse drive are placed in parentheses to avoid redrawing the figure. Each normal bearing reaction is resolved into two components F_1 and F_2 for the left bearing reaction and F_3 and F_4 for the right. The next step is to find the value of these components.

Taking moments about H

$$7F_1 - 884 \times 4.67 - 232 \times 5.21 = O$$

$$\therefore F_1 = 763 \text{ lb.}$$

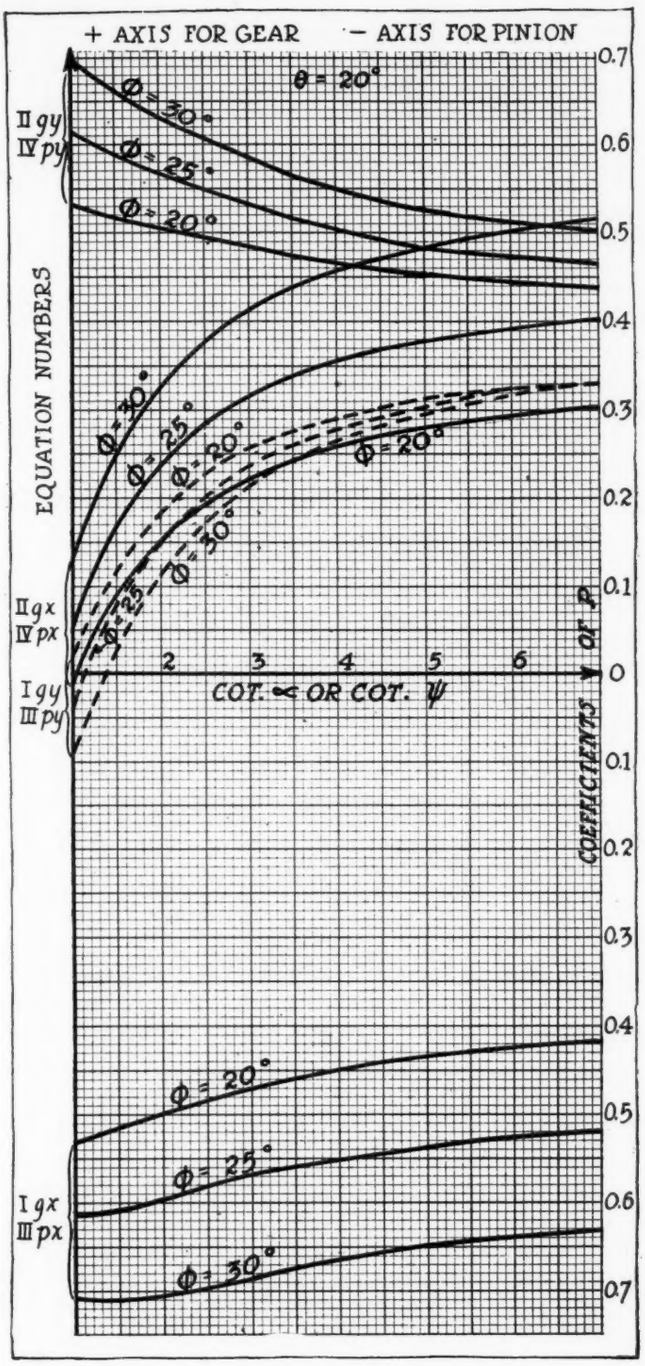


Fig. 7—Coefficients of P for gear and pinion having pressure angle of 20

$$7F_2 - 1405 \times 4.67 = O$$

$$\therefore F_2 = 937 \text{ lb.}$$

Then the total left bearing reaction is

$$R_l = \sqrt{763^2 + 937^2} = 1208 \text{ lb.}$$

The left bearing also takes the thrust of 232 lb.

In like manner taking moments about G, it follows $F_3 = 121.4$ lb., $F_4 = 467.7$ lb., and the total right bearing reaction $R_r = 483$ lb.

The first speed transmission gear ratio is 2.56:1, hence the above reactions become 2.56 times as great for first speed, 3092 and 1236 lb., respectively; while the thrust becomes 594 lb.

For reverse drive, taking moments as before:

$$7F_1 - 587 \times 5.21 + 700 \times 4.67 = O$$

$\therefore F_1 = -30.3$ lb. The negative sign indicates that F_1 acts opposite to the direction shown in Fig. 8.

$$7F_2 + 4.67 \times 1405 = O$$
$$\therefore F_2 = -937 \text{ lb.}$$

In the same manner $F_3 = -670$ lb., and $F_4 = -468$ lb. Then $R_l = 938$ lb. and $R_r = 817$ lb. It should be observed that the magnitude and direction of these reactions are entirely different from those of the direct drive. In case of the pinion bearing reactions it is generally necessary to determine their direction and magnitude for both forward and reverse drive in order properly to design rigid bearing supports.

The reverse transmission gear reduction is generally so low that the rear wheels will slip before the full torque of the motor is applied. In this case the weight on the rear wheels is 2200 lb. The radius of the wheels is 17 in. Assuming the coefficient of friction is 0.6 then

$$P = \frac{17 \times 2200 \times .6}{5.21} = 4308 \text{ lb.}$$

This force corresponds to a gear reduction of $\frac{4308}{1405} = 3.066$.

(The actual reduction is 3.42.) For slipping the wheels

$$R_l = 938 \times 3.066 = 2876 \text{ lb.}$$
$$R_r = 817 \times 3.066 = 2505 \text{ lb.}$$
$$\text{The thrust} = 587 \times 3.066 = 1800 \text{ lb.}$$

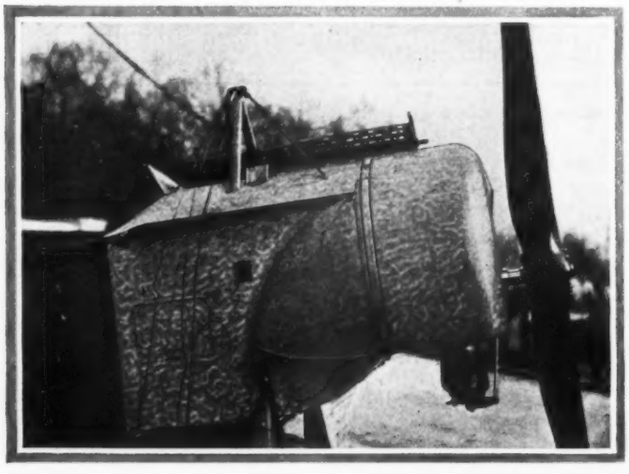
It is interesting to note that, although the torque is not great enough to slip the wheels for forward drive under the conditions as assumed for the reverse, nevertheless the maximum radial bearing pressure obtains on forward drive, namely 3092 lb. Incidentally this pressure is slightly greater than the weight of the entire car precluding the passengers. However, on reverse drive the thrust on the gear is three times as great as for forward drive.

Germans Copy Gnome Aeroplane Motor

CONTRARY to the general impression, the use of rotary air-cooled motors is by no means confined to French aviation. The German army employs the Oberursel nine-cylinder air-cooled rotary motor on practically all Fokker scout monoplanes. The Oberursel is a direct copy of the French Gnome aeroplane engine, while the Fokker aeroplane is a repetition of the Morane machine. With the exception of her Fokkers, Germany fits all her aeroplanes with vertical water-cooled motors. A few of these are six-cylinder overhead valve Benz, with vertical pushrods and rocker arms; the great majority are Mercedes engines with inclined overhead valves operated by a single overhead camshaft. Mercedes began to develop this type of engine in 1912, and in order to make more rapid progress employed the same general design for both aviation and automobile racing. These motors are produced under the direction of Heinrich Haeder, head of the aeroplane and racing departments of the Mercedes company, who has as his assistant the race driver and Engineer Seiler, who ran in the last French Grand Prix at Lyons. The latest Mercedes production is a six-cylinder motor of 5.5 by 6.29 in. bore and stroke developing 178 hp. at 1450 r.p.m. All these motors have separate steel cylinders with sheet steel jackets common to a pair of cylinders and a pair of valves inclined in the head; it is only in the racing type that four valves are employed.

Steel Cylinders Common

Steel cylinders have become very common not only in German aviation but among the Allies since the success obtained with them by Mercedes, and indications are that this type of cylinder will be largely adopted for racing and high efficiency car motors after the war. The construction is not costly, there are very few manufacturing difficulties, the combustion chamber is machined all over, water circulating space can be carefully verified, and the design is lighter than block cast cylinders. In most cases cast-iron pistons are used; but several manufacturers are designing these motors to run at 2400 r.p.m. instead of 1200, with the propeller geared down at a 2 to 1 ratio. This has necessitated lighter reciprocating parts and a considerable amount of successful experimental work has been done with aluminum pistons.



Engine housing and machine gun on captured Fokker monoplane. Engine is a rotary Oberursel like the French Gnome

In the German army much importance is attached to uniformity of design and construction. Thus, motors are invariably mounted in the front of the fusilage, with the tractive screw on the propeller shaft and, of course, running at engine speed, which never exceeds 1400 r.p.m. During the early months of the war the radiator was mounted on each side of the fusilage; this, however, was an exposed position, any stray bullet being liable to break a tube and cause the total loss of cooling water. More recently the radiators are of the honeycomb type, very similar to those used on cars, mounted in the center of the upper plane, with the head inclined considerably toward the rear. The entire cooling surface, which measures 6 meters 80, is above the top of the engine, instead of being below it as on the old type, and the maximum protection is obtained against stray bullets. All German motors, whether Mercedes or other make, are partially silenced, the exhaust gases being drawn into a collector, and the exhaust pipe carried upward and inclined to the rear to a point slightly above the top of the upper plane. With the exception of the Fokker all machines are biplanes.

No German V Engines

Germany appears to have paid no attention to V motors. This can be understood in view of her passion for uniformity. Before the war a very satisfactory type of vertical six-cylinder water-cooled motor was evolved, and the German authorities have remained faithful to this type during the war. The French, on the other hand, have refused to be bound by a mediocre uniformity, and in the midst of the war have not hesitated to give engineers a free hand and adopt the best that they could produce. Thus, the 20 months of war have seen the decline of the rotary and the rise of the six-cylinder vertical and various eight- and twelve-cylinder V motors. The rotary has not been abandoned, for recently there has been a rise in favor of the Rhone engine. This motor, originally a rival of the Gnome, was bought up by the Gnome company 2 or 3 years ago and produced by them. It has been found more satisfactory than the original Gnome and is being built in bigger quantities than the Gnome.

High Spots in S. A. E. History

Tracing the Growth of the Society

By Coker F. Clarkson
General Manager

WE can doubt philosophy and at times ignore friendly advice, but we must listen to wisdom and experience, particularly when the fruits of these are presented in a non-partisan manner for the common good by way of rational co-ordination of governing factors in the adequate development and orderly conduct of an industry. In any industry based upon engineering, the originating department of design, and the consequent department of production are, it is obvious, primarily determining of business success in general, although this fact is not usually given due force by controlling executives in industrial inauguration, and receives belated recognition in some degree, after an industry is well started.

In the case of the automobile industry, which in addition to being very complex and involving endless data a large part of the mass which is undergoing constant development is essentially one of quick decisions and speedy operations; the amount of broadly co-operative engineering work which has been under way for a decade is remarkable from any standpoint. The results of the work are monumental in diverse ways, fundamental among these being prompt presentation and discussion in assembly by qualified experts of design innovations appearing on the horizon, as well as consideration of comprehensive collated data of engineering elements already developed to a material degree (representing the more or less classic idea of professional societies and associations), and the majority, followed by the general, adoption of thoroughly considered formulations of recommended practices and standards of those features of specification, design (in part) and production which represent epochal development and which it is irrational to have differing in an immaterial way.

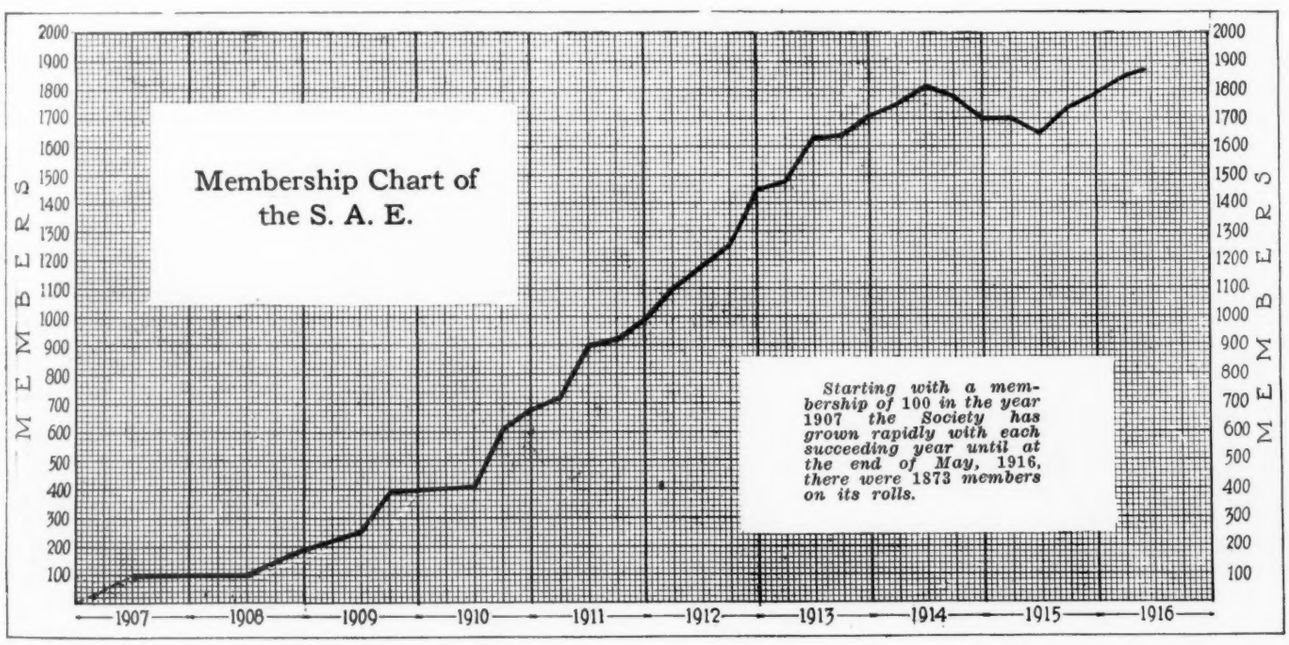
The dominant agency in the planning and conduct of the accomplishment of the progress which has been outlined briefly is, and has been for many years, the Society of Automobile Engineers.

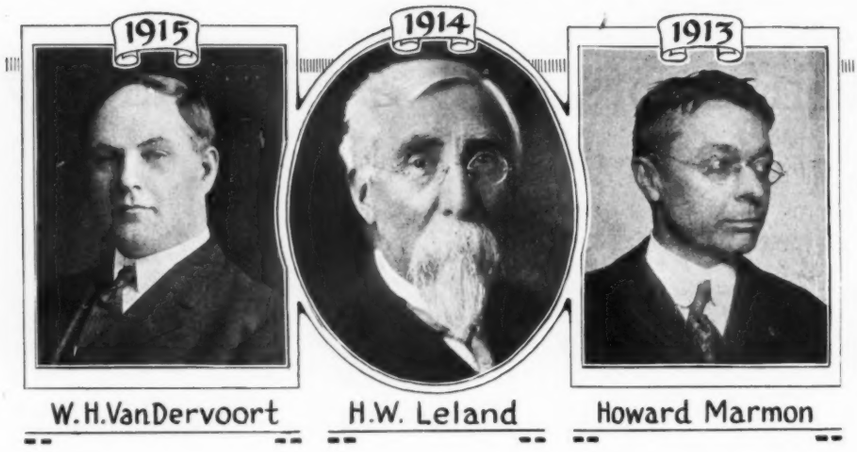
It is the expression of mechanical genius of the American automobile industry. Its work relates to to-morrow and the day after to-morrow, not the past. Constant investigation and research are necessary to even keep pace with the advance in the automobile building art.

Coker F. Clarkson, General Manager, S. A. E.

Founded over 10 years ago, this band of congenial spirits has expanded constantly from a few to upward of 2000 men, associated with nearly 1000 different companies engaged prominently in the automobile and allied lines of production. The early records of the Society are more or less indefinite, but it is clear that the same feeling of fellowship and eagerness for progress, which are so familiar to-day, prevailed during the days when the problems of the members were not so great in degree although not really different in kind.

The impetus of the later and present advance of the Society had its inception shortly subsequent to the discon-





tinuance of the Mechanical Branch of the Association of Licensed Automobile Manufacturers, in which many of the pioneer and leading American automobile designers and superintendents had taken an active part for several years. In 1910 a staff was put to work in the office of the Society, and at that time the aggregate membership was about 400.

An Enthusiastic Session

A large, enthusiastic meeting was held during the summer, a relatively large number of papers being presented on such subjects as pyrometry, testing of metals, engineering basis of vehicle taxation, variation in practice of anti-friction metals, patents, gear grinding, test data on frame sections, smoky engine exhaust, non-poppet valve engines, motor trucks and automobile nomenclature.

The Standards Committee

The paper on non-poppet valve engines represents a type which has been very well received, and valuable in the proceedings. A report on specifications for materials, steels, iron, bearing metals and aluminum alloys was submitted, this being a revision of the specifications which had been issued annually theretofore by the Association of Licensed Automobile Manufacturers. From these, the standards of the Society for the metals in question have been evolved, through several years of work of the Iron and Steel Division of the Standards Committee.

The most significant feature of the first summer meeting, so far as the recent work of the Society is concerned, was the vote of the Society that a Standards Committee should be appointed to take up in a thorough way this most important feature of the Society's work.

A Rapid Growth

In 1911 the publications of the Society became about twice as extensive as they had been before. The 1911 annual meeting of the Society, held at the Automobile Club of America, was attended by about 250 members and 150 guests. The election of over 300 additional members during the latter part of the previous year was reported. Discussion was held as to the advisability of the Society meeting during the time of the annual automobile show, a dilemma that is always present. The attendance of the professional sessions is undoubtedly affected adversely by the alluring show attractions, so far as members in town at the time is concerned, but on the other hand, the best opinion probably is that the show is the time for the annual gathering as the members cannot get time to make two trips from home within a short period and want to attend the automobile show. The present theory of the Meetings Committee in this matter is to shorten the length of the annual meeting, making it so attractive as to counteract the show "competition."

In 1911 The Iron and Steel Division made its first report on specifications, these being accompanied by notes and instructions on the use of steels and their heat treatment, descriptions of forms of testing and metallurgical definitions. The work of standardizing a stock list of ball bearing sizes was inaugurated at this time, many years of struggle having followed before it was possible to get foreign and domestic bearing manufacturers to agree upon a satisfactory basis, relating particularly to permissible variation from nominal dimensions.

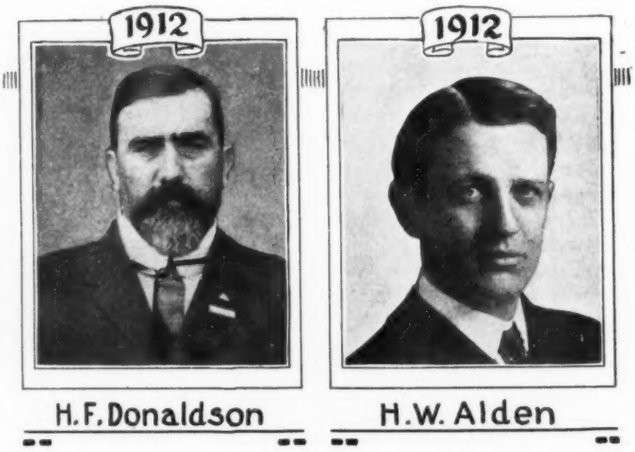
The Sheet Metals Division and the Broaches Division, which have since submitted valuable data for general reference and which before long resulted in accepted practice, began activities at this period. The table of sizes of seamless steel tubing, which had been established by the Mechanical Branch, was reduced about two-thirds in size and a thorough investigation was made on the question of whether the tolerance practice which had been established could be changed to give a condition of greater accuracy; with a negative result. A test was made at the A. C. A. for the benefit of the members on the effect of multipoint ignition on the performance of automobile engines.

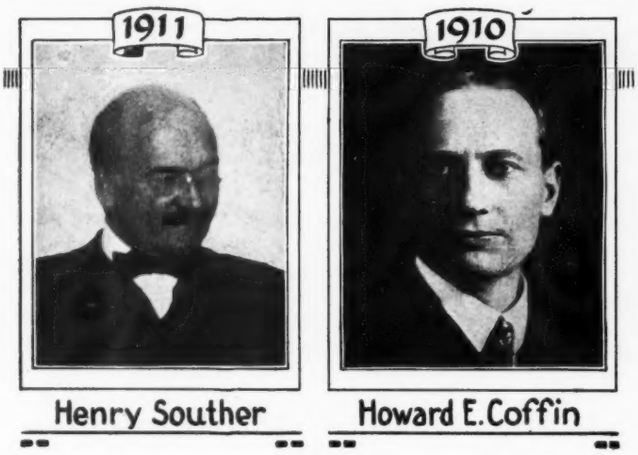
Many Papers on Springs

At most of the meetings held in recent years, papers on spring suspension have been presented, as they doubtless will be at meetings for some time to come, this field of engineering being apparently one of the most complicated with which the members have to deal.

The very promising session on automobile fuels, to be held next week on board the Noronic, is, in a way, a culmination of discussion which has been conducted by the members for years. "What is commercial gasoline?" was the question asked at a meeting of the Society 5 years ago, it being pointed out that there was no standard to refer to. We are now at the stage of actually determining what can be done in the way of utilizing kerosene as fuel in engines modified to the extent that shall be necessary. The possibility of benzol as a fuel was brought up for discussion in a meeting several years ago.

One of the most informing phases of the proceedings of the Society is the number of papers which have been submitted on the commercial testing of engines, full pertinent details being given. The matter of putting into effect forms to be used in the testing of engines for the purpose of secur-





ing practical results of performance of different products is still under advisement of a committee of the Society, and will develop into even greater benefit to the members than has already been received by them as to the making and checking of tests.

The Handbook of Data Sheets

The S. A. E., so far as I know, is the only organization of the kind which has undertaken and carried into effect a loose leaf form of engineer's pocketbook known as the "Handbook" of data sheets of the Society. The sheets, the preparation of which involved a great deal of detail, are furnished to the members without cost in addition to the conventional dues, supplemental and revised sheets being distributed twice a year, together with up-to-date indices when required. The last list of sheets giving the substance of matters referring essentially to the Society work shows that there are 110 items to be credited to standardization achievement, many of these items consisting of groups of various subitems. The policy of the Society with regard to the dissemination of its standards publications has been very liberal from the first. Reprints of data sheets are furnished free of cost to any legitimate inquirer, and additional sheets at a nominal sum. These sheets are used widely in different fields of engineering besides that of the automobile industry.

It can be said that the growth and value of the Sections of the Society, the first of which was established in 1911, have exceeded the fondest hopes of the members. The local organizations with headquarters at Detroit, Cleveland, Indianapolis, Chicago, New York and Philadelphia, have a high average of enthusiasm, friendly intercourse and performance in furnishing helpful engineering knowledge to the membership of the Society as a whole, and to the public. About one-half of the annual volume of Transactions of the Society is constituted of papers and discussion presented at meetings of its Sections.

The S. A. E. *Bulletin*, which was started in a desultory way in 1911, became a regular monthly publication with second-class mail permit 3 years ago. The current issue of the *Bulletin* contains 256 pages.

There is a form of membership of the Society called the Affiliate grade to which firms and corporations engaged in the manufacture of automobiles or trucks or the manufacture of parts and accessories used in connection therewith, are eligible. Affiliate members have the right, subject to the approval of the Council of the Society, to designate personal representatives up to a total of six. The interest of many firms is served by the Society, who have the opportunity, through their representatives, to bring to the attention of the latter many things that can be discussed with mutual advantage. Affiliate membership was established in answer to a distinct demand. Frequently firms want their employees to have the benefit of the publications of the Society. Many of these employees are more or less fleeting, they are at one time with one firm, then with another. Through the Affiliate membership firms can secure the advantages of knowledge their employees get through contact with S. A. E. members, attendance at meetings, reading of papers and reports and participating in discussion. It is felt that the Society owes a duty to many firms and companies who should have a channel through which they can present much valuable material in the way of experience, all of which redounds to great progress in automobile engineering, and many allied lines of the automobile industry.

A Visit to Europe

In 1911 the Society made its first official visit to Europe, going to England and France. The reception accorded was most cordial and elaborate. The members were admitted to renowned factories that had never before been opened to outsiders. Among the tangible results of the trip were the acquisition of a great fund of technical information by members of the party at first hand; the making of valuable acquaintances, both as between members of the Society and between them and foreign members of the industry, important commercial and technical relations resulting in many cases; the opening of avenues of information and interchange of ideas between American and European engineers; and the accruing of benefits to the industry at home and abroad.

The I. A. E. as Guests

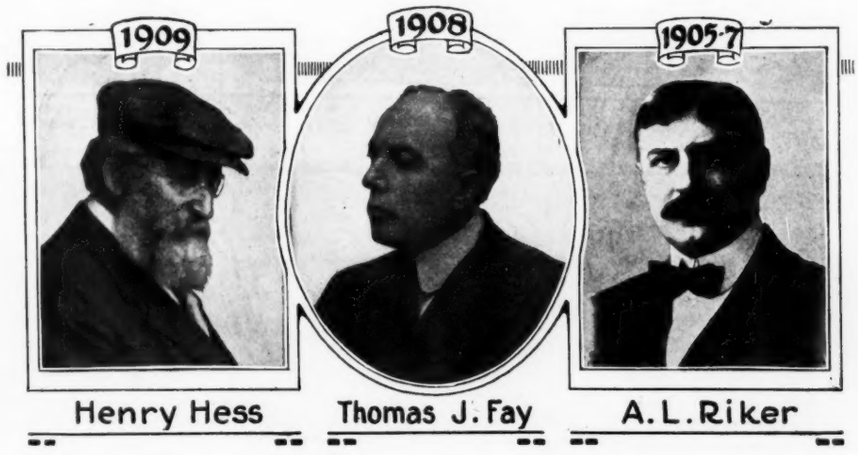
Returning this visit, a party of British engineers came to America in 1913 to attend the semi-annual meeting of the Society and to go on an inspection tour of automobile manufacturing establishments throughout the country, under the auspices of the S. A. E.

It can be said unqualifiedly that as a result of the Society's careful and thorough work, the barriers which existed between American automobile engineering and that of our English cousins have been broken down.

As showing the breadth and nature of the Society's activities the following paragraph of its Constitution is interesting:

"The Society shall claim no exclusive copyright to any papers read at its meetings, or any reports or discus-

(*Continued on page* 1043)



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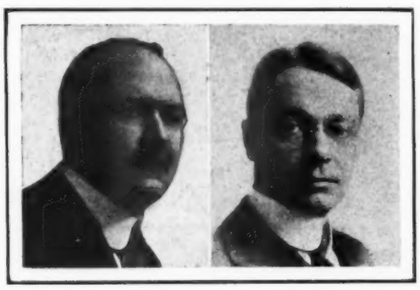

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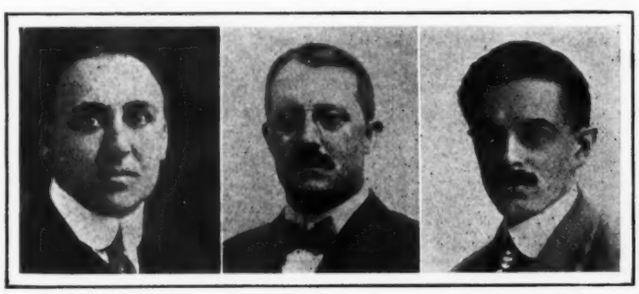

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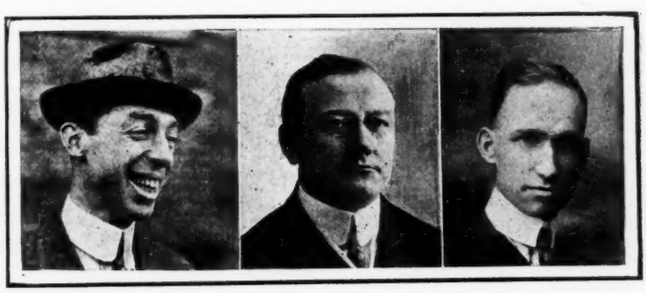

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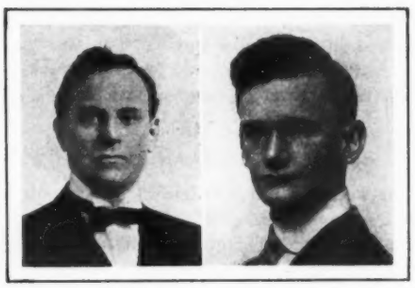

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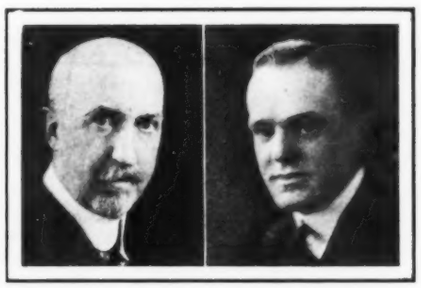

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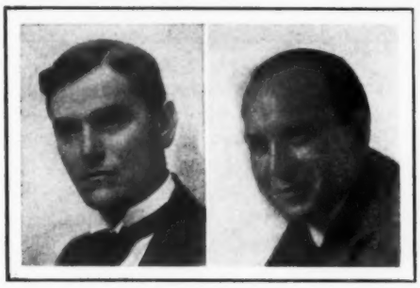

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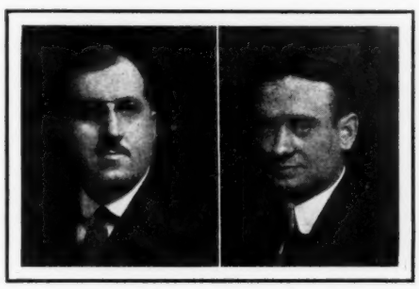

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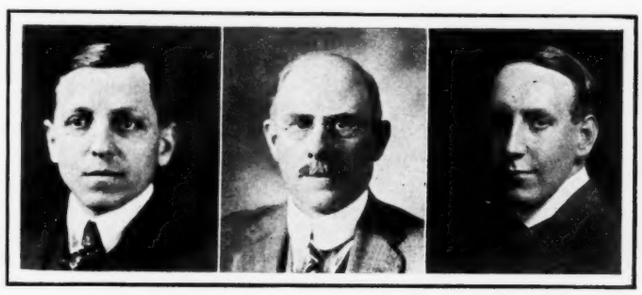

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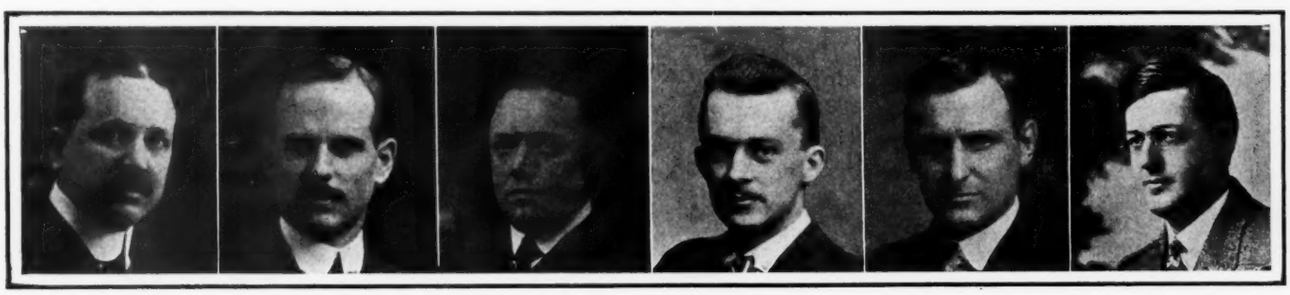

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Aviation Engines

What Has Been Learned by Automobile Engineers Through Study of Aircraft Abroad—Development Points to Many Cylinders

By J. G. Vincent
Vice-President of Engineering, Packard Motor Car Co.

AT the beginning of the war there was no settled opinion in Europe with respect to the proper number of cylinders and the best cylinder arrangement, or indeed many other details in aircraft engine design. The only concerted plan possessed by any foreign government was that of Germany, who was contented to leave the task entirely in the hands of the automobile engineers. The latter naturally made use of their automobile knowledge, making the aircraft motors just as they would have built engines for a racing car. This produced a high speed motor with a high volumetric efficiency but not astonishingly light to the proportion of the power developed.

The Mercedes is the best known German aviation engine, and readers of THE AUTOMOBILE are all familiar with its construction and its reliability. It is nothing more than a good vertical six-cylinder in which lightness is obtained by making every possible use of very strong materials. In France development was around an entirely different line and before the aeroplane had demonstrated its military value there were many French aircraft engineers who, being rather ignorant of automobile engineering, developed peculiar engines aiming principally for intrinsic lightness.

Owing no doubt to the great success of the Gnome rotating cylinder engine there was a strong tendency in this direction and rotary engines were developed to a point where their volumetric efficiency was high and they produced a remarkable power per pound of weight. Repeated trials, however, showed that the typical French engines seemed unable to make very long flights while it was common knowledge that the need for frequent tearing down, cleaning, etc., was a distinct trouble. Long before the war it was pointed out that in figuring the weight of an aircraft engine its consumption of fuel and oil should be taken into consideration, because if this were not done the true weight efficiency of the engine would not appear.

Long Flights the Problem

Under war conditions scouts are required to make long flights and the enormous bulk of fuel and oil needed by most of the French motors made them undesirable for anything except very short trips. For long flights the water-cooled engine of much higher fuel efficiency was actually lighter as well as being more reliable. Realizing that something had to be done, and done quickly, the French automobile industry was appealed to, thus receiving official backing which had produced the Mercedes motor in Germany.

Some of the French engineers followed the Mercedes lead, building water-cooled six-cylinder engines. Others already had air-cooled eight-cylinder or twelve-cylinder V-type engines and these, together with newcomers, commenced to make water-cooled six- eight- and twelve-cylinder engines in addition. In England development had been somewhere between the German and the French system so that the British machines were usually better fitted than French.

Despite the apparent strong tendency toward the elimination of the old idea of an aeroplane engine and the substitution of something much more like an automobile motor, it is to be doubted whether there will ever be one ultimate type. Some of the rotary cylinder air-cooled motors have done excellent work in very light scout machines possessed of extreme speed and with ability to rise very rapidly, and it may be this type of engine will continue to find its scope in this field. As soon as it is necessary to carry much weight, such as passengers and ammunition, etc., so far as can be ascertained it is the fixed cylinder type of engine which is used almost invariably.

Leaving the rotary motors on one side and confining consideration solely to the fixed cylinder pattern, there are a number of varieties from which to choose. The four-cylinder is not admissible, partly owing to its inherent vibration and partly because its dimensions would need to be very large if adequate power were to be obtained. The typical German pattern of six-cylinder can be made to give excellent service, but even with six-cylinders we soon come to the practical limit of power.

Width Is a Limit

Using gasoline, we obtain a certain temperature of explosion and this intensity of heat limits the piston size quite definitely. It is noticeable that everyone who has studied the fighting aircraft in use to-day comes back impressed with the immense speed capability of the machines and their enormous power. At first the six-cylinder was able to take care of conditions, then, as more power was asked for, the eight V-motor came into favor, but this was only able to carry the power range a little farther than the six so it was followed rapidly by the twelve-cylinder and it is doubtful if even the latter can be made to give sufficient power for the planes about to be built. One suggestion which is perfectly practical is that of an eighteen-cylinder engine with three sets of six-cylinders arranged fanwise on a single crankcase with a single crankshaft. It is believed that some of these motors are being constructed in England and, theoretically, the only disadvantage appears to be the fact that such a construction will be rather wide. The desire to keep down the width has been largely experimental in developing the twelve-cylinder aviation engine as opposed to the eight. It is stated as a rule that the fusilage of a high speed plane should not be over 26 in. in width and it is none too easy to get even a 60-degree twelve-cylinder engine within that dimension.

Packard Co. Plans

It was with this information before us, and with a feeling that someone in this country should put in some real time developing aircraft motors (partly because we believe there may be some commercial future in it, but largely because we think this country may need some type of that motor)

that the Packard Co. set out to develop a twelve-cylinder or rather, a couple of twelve-cylinder aviation motors. Of course, having settled the type of motor, it became important to consider the thousand and one details.

The first important detail that came up for discussion was the matter of propeller ratio. That is, whether the propeller should be mounted direct on the crankshaft, or geared down. Of course, if it is mounted direct on the crankshaft, the motor speed is limited to not over 1200 to 1400 r.p.m. In other words a load-carrying machine will run approximately 1200 r.p.m. at the propeller and, in the very heavy load-carrying machines, it is sometimes desirable to run the propeller as low as 900 r.p.m. So it seemed very desirable to gear down the propeller, but we knew that there were a lot of problems to be met in the geared down construction. While it has been experimented with to a considerable extent, there has been much trouble experienced. So far as that is concerned, the direct driven machine, with the propeller mounted on the crankshaft, is not free from trouble, by any means. Out of balance of the propeller is bound to exist, in spite of fine workmanship. This, coupled with the inequalities of the air through which the machine may be flying, puts some very heavy stresses on the propeller and its mounting. A test that one of the foreign governments is putting on propellers now amounts to something like mounting a seven-pound weight 30 in. from the center of the propeller, and running the engine at its rated speed for some considerable length of time. That may not sound like much, but it will come pretty near walking off with the dynamometer base at 1400 r.p.m.

Propellers Break Crankshafts

The out of balance that exists in propellers is, I believe, responsible for crankshaft breakage on the direct-driven outfits. Many engineers have been working on aeroplane motors who know much more about that subject than I do, but they all agree that the crankshaft is one of the very weak links in aeroplane motor construction. I do not know whether they would agree with me that crankshaft breakage is very largely due to inequalities of balance of the propeller, or not, but nevertheless, I believe that has a very important bearing on it, judging by the way the crankshafts break.

It would seem, in going to the geared type, that we get away from some of the strains on the crankshaft due to the propeller, but of course we must put them somewhere else. A short lay shaft, which must be very rigidly mounted, on very heavy bearings (and those bearings must, of course, provide for radial load, and also for end thrust), seems the best practice using very large self-aligning ball bearings at both ends of the short shaft, and mounting a very heavy double thrust bearing in between. This, of course, causes the use of very substantial gears, to gear down with, and provides ample means for cooling them with oil. I believe that with a properly designed outfit, an efficiency between 98 and 99 per cent can be obtained. This mounting must be very rigid, and I believe it is desirable to cast the crankcase and the case to carry the propeller mounting out of an alloy a little stronger than the ordinary aluminum.

Valve Location a Study

One of the next things that might be considered is the location of the valve. We, of course, know that we want the most power we can get, coupled with the best possible economy and reliability. Noise is not so much a factor, so that we naturally come to the valve-in-the-head. Of course, it is not absolutely necessary to use two overhead camshafts, but it seems desirable, as it does not necessarily add greatly to the weight of the motor, and it very greatly lightens the reciprocating valve parts. This is particularly desirable with the geared down type of motor, because it will probably be desirable to run the motor in the neighborhood of 1800 to 2200 r.p.m., and it must be remembered that, in an aeroplane, the motor is always running, when it is running, at its rated load. It is not like an automobile motor, that is working about one-tenth of its speed the greater part of the time; and some surprising things happen when you put a motor in an aeroplane.

The overhead camshaft is, of course, of very clean-cut construction, and allows a good clearance for the mounting of the carbureter and exhaust pipes. There are, of course, two general schemes in use for mounting carbureter and exhaust pipes. One is to put the two carbureters, one each on the outside, and mount the exhaust pipes in the center. The other is, of course, to mount the carbureters in the center, and the exhaust pipes on the outside. I think that individual mounting in the plane will determine the location of these accessories. It is a little cleaner-cut proposition to mount the carbureter in the center, as low as possible, with the manifold, and put the exhaust pipes on the outside. I believe this is particularly desirable, as the spark plugs should, in my estimation, be on the inside, where the oil will drip off from them, and it would be undesirable to have the exhaust on the inside and the spark plugs also, as more preignition might result.

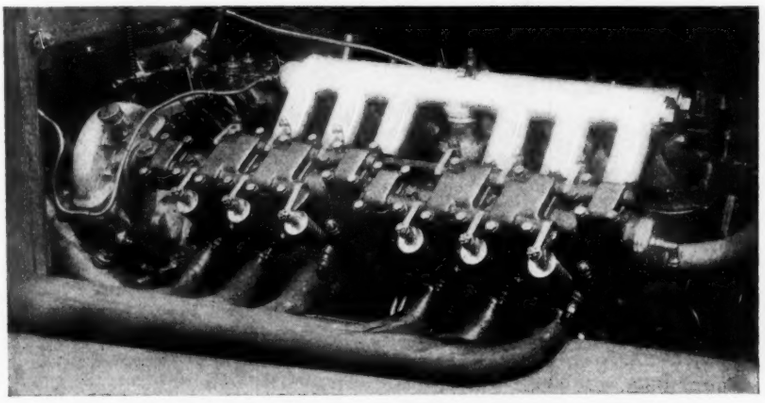
Points in Cylinder Construction

The next point that might come up would be the cylinder design. There are a number of constructions that are fairly satisfactory. The straight cast iron cylinder can be made rather light, especially when you take into consideration that you can nowadays weld jackets onto the cast iron and make quite a light construction. We know that it is good and reliable, and it is probably as cheap as any construction which has been developed up to this time.

Of course, another construction is to use aluminum with steel liners, either casting the cylinder separately, and leaving the head integral with the cylinders, so that you have to take the cylinder off to take a valve out, or casting the main barrels of the cylinder integral with the crankcase, and pressing the liner in, and bolting the head on.

Then there is still the Mercedes construction, of steel cylinders made out of forgings, all properly machined up and welded together. In my opinion, the steel cylinder is the best possible answer, although it is the most expensive, and the hardest to make, and may require considerable experimental work before we find out how to do the job in this country as well as they do it in Germany.

Of the other two constructions, I believe that the aluminum



Small size Packard aviation engine with overhead camshafts and two valves to each of the twelve cylinders

cylinder is more apt to survive than the cast iron, on account of the weight.

Location of Accessories

One of the problems that comes up next is the location of the accessories, and what accessories we want to carry. We of course got in touch with many foreign engineers, as well as our American engineers, and consider carefully the various problems regarding equipment. Practically without exception, they all said that they wanted electric lighting and starting, if it could be put on so that it would operate successfully. They had had experience, however, with badly designed electric lighting and starting, and were more or less skeptical about the design, of course. However, the need for electric lighting and starting seems to be just as great as it was in the automobile, and even more so; because, if your motor stops up in the air, and if you are in a dangerous place, it would be very desirable to start it if you could. So that we are planning to try to get the best possible work out of the electric generator lighting and starting motors for turning the big motor over. You will understand, in coming to these big units, it is pretty hard to turn the motor over anyway, considering that there are twelve cylinders, 4 by 6.

Overcoming with Difficulty

It has already been announced in THE AUTOMOBILE that the Packard company is building a 900 cu. in. twelve-cylinder aviation engine and it may be interesting to show how the width of this large motor has been kept down. As stated earlier in this article, it is far from easy to get a large motor with the cylinders set at 60 deg. sufficiently narrow to be installed in a fusilage 26 in. wide. In order to overcome this trouble the big Packard engine will have the cylinders at 40 deg. The object of putting them at 60 deg. is, of course, to divide the impulses evenly. Both sides of the twelve-cylinder motor are in perfect natural balance, so a change in the angularity of the cylinder blocks will not affect the balance, although it will affect the impulse frequency.

Careful experimental work, however, reveals the fact that the very slight variation in impulse frequency due to setting the cylinders at 40 deg. cannot be detected above speeds of 400 to 500 r. p. m. Seeing that the aeroplane engine runs at a practically constant and much higher speed, this low speed variation is not important.

It has been found that building the large twelve-cylinder Packard engine with a 40-deg. angle saves approximately 7 in. on the width. It also saves a little weight and adds a little to the strength.

Expects Battery Ignition

As to ignition, the foreigners nearly all wanted magnetos, because they are not familiar with the present state of the generator ignition art in this country. I believe it is desirable to design an aeroplane motor so that either magnetos or the generator type of ignition can be used. It is my belief that as electric lighting and starting becomes popular, as I am sure it will, the generator type of ignition will go with it.

It is, of course, necessary to provide an accurate tachometer, which is driven off the camshaft, and also an air pump for providing either pressure or vacuum. There seems to be a growing tendency to use vacuum for the gasoline feed, on account of holes being shot in the tanks, and releasing the pressure.

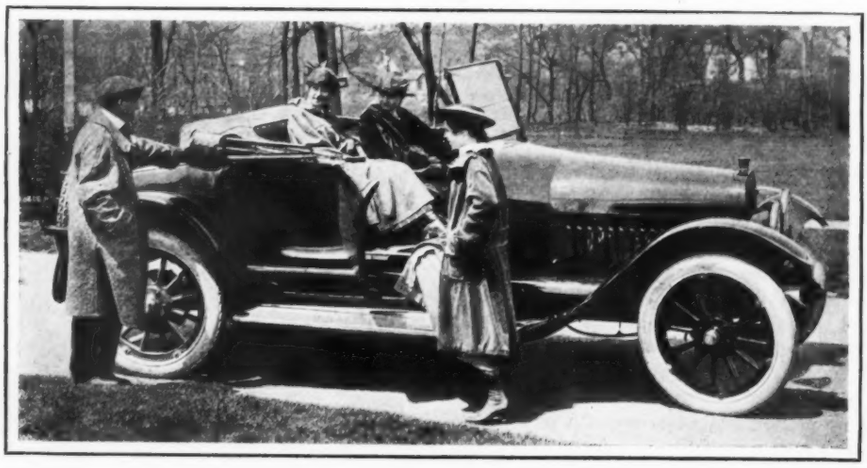
I will just very briefly run through two other points here: Lubrication is course pressure feed, and there are two general systems in use. One is to carry the oil in the sump, and the other is to pump it all out of the sump, and pump it through a radiator. I have not had enough experience to be able to make any prediction as to which is the better. A great many foreigners want two spark plugs in each cylinder, more for reliability than because it is necessary for power. The radiator location is a very important question. It makes the nicest looking job to locate it in front, but it does add somewhat to the head resistance, although if properly designed, and not over 26 in. wide, it makes a very good work out in a large motor. Of course, the other arrangement is to locate the radiators one on each side of the fusilage.

Weight Second to Reliability

My investigation showed that weight is secondary to reliability and economy. Just one word as to workmanship on aircraft motors. This sort of motor will, of course, have to carry with it workmanship that we could not possibly afford to put in an automobile, and it would not do any particular good if it were put in an automobile. In other words, it is absolutely impossible to put a gasket in an aeroplane motor in any place. You might possibly use it between the intake and the carbureter, but no place else. The constant weaving of the motor in the air seems to just naturally work the gaskets loose, and they blow out. In other words, every joint must be a lapped joint, so that they can be taken down any number of times without leaking, under any conditions.

Seats Staggered in New Three-Passenger Mitchell

THE Mitchell-Lewis Motor Co., Racine, Wis., has brought out a three-passenger roadster as an addition to its line for 1917. Some features of the new car are the staggered seating arrangement, slanting windshield and the close-up position of the driver without any segregation of passengers. The



Mitchell six chassis with its long wheelbase, cantilever springs and the two-unit, three-point suspension, which, like the other features of construction, are the ideas of the company's designer, J. W. Bate, is particularly adaptable to the roadster type of body. The illustration brings out its smart appearance.

Industry's Debt to the S. A. E.

Part of Engineers in Development of Automobile Business Should Be Appreciated—Great Results from Small Beginnings

By Russell Huff
President S. A. E.

THE rapid development of the automobile industry has aroused the curiosity and admiration of the world. Never in the history of mankind has an industry grown like the automobile business in the United States. It is now classed among the half-dozen largest enterprises in the country.

A New Dynamic Force

When one reflects that this wonderful evolution has been brought about in practically fifteen years' time, one naturally inquires the reasons for such an unusual growth. Of course, capital has played its part in the development of this business, but without a new dynamic force, frank co-operation and able standardization, the industry must have gone forward at a much slower pace.

Spirit of Co-operation

What once looked like a plaything in the business field has now become a real octopus in size and economic importance. Much has been said about the captains of industry who have risked their money and labored day and night for the success of the business, but little is said about the part the silent engineer has played in laying the foundation for the present state of this vast industry. Ten years ago the chief engineers of the leading companies were meeting regularly every month, exchanging ideas and devising standards for the general good of all. These early engineering conferences established a spirit of co-operation between the representatives from the various companies then engaged in the automobile business, which has been maintained through a period of ten years.

Value to Industry

These engineers early recognized the value to the industry, which was even at that time growing by leaps and bounds, of perfecting and adopting many standards for use in automobile construction. The wisdom of undertaking this work in the early history of the business cannot be overestimated, as no one can now figure in dollars and cents the value of the existing S. A. E. standards to the motor car industry. A recent investigation among manufacturers has shown that a large majority are making extensive use of the standards established by the Society.

The S. A. E. screw and bolt standards, which have been specially developed to meet the needs of the industry, are used by 94 per cent of the manufacturers. S. A. E. lockwasher standards now include thirty-five sizes instead of three or four hundred sizes formerly used and are standard practice with 90 per cent of the makers. The S. A. E. spark plug thread size is used by 93 per cent of the producers. These figures merely show a few of the S. A. E. standards which have practically become universal in their use by the industry and are cited to show the far-reaching effect of the early work done by the pioneer engineers in their original monthly conventions.

Energy in Standardization

Dozens of equally valuable standards have been adopted and recommended by the Society and are rapidly being taken up by the different manufacturers. This standardization work has been a great benefit to the manufacturers by permitting a steady reduction in the cost of cars and actual improvement in quality. Finally, the purchaser benefits through the steady reduction in the original price of cars and cost of maintenance. The work of standardization is never finished. The automobile industry is developing so rapidly that constant investigation and research are required. This work is being carried on with greater energy at the present time than ever before. The brightest minds among the automobile engineers of today are at work on numerous problems.

Results of Foresight

It is doubtful if the present methods of rapid manufacture, the low cost of production and the high quality of automobiles could all have been realized in such a short space of time without the untiring work of the engineers, whose foresight and interest in the future of the business spurred them on to sacrifice their valuable time to meet and work out the solutions to the many different problems always encountered in any standardization efforts.

The industry surely owes a debt to the S. A. E., the value of which can never be estimated, and that debt will grow larger as the industry expands, for the S. A. E. will grow in unison. There is no branch of engineering that does not lean upon the work of its societies.

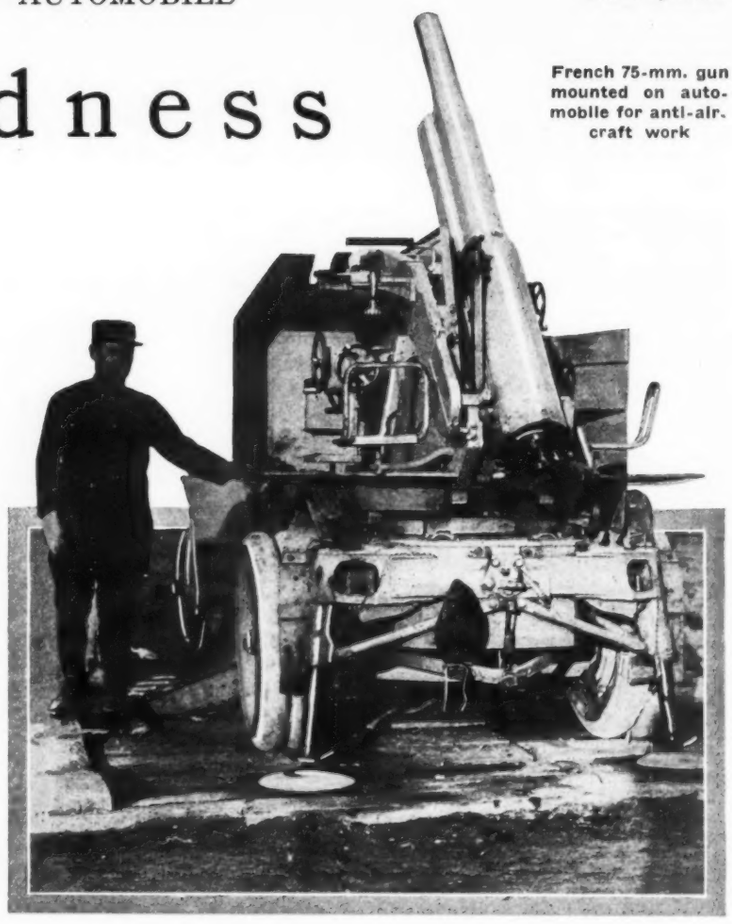
Preparedness

and Motor Trucks

A Review of the Lessons Learned at Heavy Cost in Men and Money by the European Belligerents

Part I

By Donald McLeod Lay



French 75-mm. gun mounted on automobile for anti-aircraft work

WITHIN the past few months the necessity for utilizing motor trucks and automobiles in the expedition into Mexico after Villa has brought home very strongly to the car and truck engineers and manufacturers as well as to the United States army officials the fact that ordinary commercial vehicles are not best suited to military requirements. All these men have been interested in the work of motor vehicles in the European struggle and have watched closely for any salient features in design and manufacture resulting from the experiences brought by war conditions. Still there are numerous points that have not been brought out very strongly but which a review of the development of the motor arm of the service in the European armies throws into relief.

At the outbreak of hostilities it was estimated that there were 100,000 motor vehicles in use with the French army, 18,000 of these being trucks, including 1100 buses, 200 four-wheel-drive tractors, fifty motor searchlights and 100 special vehicles. When the British expeditionary force first established itself in France it was estimated that its motor vehicle equipment comprised 2500 to 3000 machines, the great bulk of which were requisitioned among motor truck users and manufacturers' stocks, the British army's subsidy system at that time having progressed very little beyond the paper stage.

No Uniformity in Vehicles

In comparing the equipment of these two armies the French vehicles were then far superior to the English for military purposes, the latter being of such diversified types that they were not suitable for working together in convoy formation, some of them in operation in convoys having speed abilities varying from 7 to 17 m.p.h. Not only were they of different makes but the bodies were of all kinds for the trucks had been taken direct from private service without even removing the advertising matter with which they were usually almost covered. These convoys worked fairly well on level ground but as soon as hills had to be negotiated the slower vehicles and the defective ones dropped back, thus delaying the entire convoy. Hilly country also necessitated passing and repassing, which of course was dangerous, many radiators being smashed owing to cars running backward down the hills due to the lack of provision of sprags. With a closely spaced procession a rear movement of a few feet would be sufficient to cause an accident. These defects were known to the officers in charge of the motor vehicle service but of course there was no time to remedy them when war had been declared. The French authorities, however, had been working on this problem long enough—8 years—to have created what may be termed a model type of truck in all the factories. These vehicles, although differing considerably in design, were uniform in power, size, speed, load capacity, body, clearance, tire sizes and in such details as sprags, towing hooks, radiator guard, magneto and carbureter.

The English subsidy specification was based on the Leyland chassis and practically ordered manufacturers to abandon their own designs, no matter how good these might be, and accept that provided by the war office. As a proof of the indifference which this scheme met from the manufacturers, the last British army trials before the war comprised only three vehicles as compared with 110 trucks participating in the last French trials at that time.

Under the French scheme, as originally adopted, practically every manufacturer was able to enter with his standard types, there being no preference for bevel-drive over worm or chain, for a particular type or position of motor or for a certain class of gearbox. The field was even left open to steam, gasoline and gasoline-electric machines, the only requirement being that the trucks should be capable of doing good work on the road individually and collectively. Year by year, the regulations and tests became more stringent without, however, interfering with the general design. Thus a type of vehicle of uniform size, power, weight, speed, body, clearance, etc., was developed throughout the country so that when the war broke out practically all the best trucks in France were subsidized types. When called into actual service some of the features on which the army insisted, although of little importance to the private user, were justified. They are the use of sprags, sufficient clearance, radiator guard, uniform bodies, towing hooks front and rear, three-fuel carbureters and tanks allowing a big range of action.

An Early Peace Expected in 1914

It is interesting that in October, 1914, the end of the war was confidently expected in France to be very near, 1915 being looked upon as a dead year or go-between year in the automobile business. At this time it was estimated that the French Government owned 70 per cent of all motor vehicles

both cars and trucks, of 12 hp. and over in that country.

The Germans had large numbers of armored cars in readiness at the outbreak of the war and used them with great effect, being able to keep up a steady fire until the enemy was almost upon them and then to get away in safety with cars and guns.

The ability of the German army to shift masses of men from one front to another in extremely quick time has been one of the features of the war and is credited to the systematic use of automobiles and motor trucks in transporting men, supplies and ammunition. Many of the German armored cars in use early in the war were nothing more than commandeered touring cars fitted with plates of steel to protect the vital parts and sometimes the occupants.

Automobile artillery batteries were found of inestimable value almost from the beginning of the struggle. In many cases ordinary 2½-ton chassis were used, the guns being fitted by the arsenal. Better results were obtained however with specially designed chassis having provision against the recoil of the gun and a certain amount of armor plating.

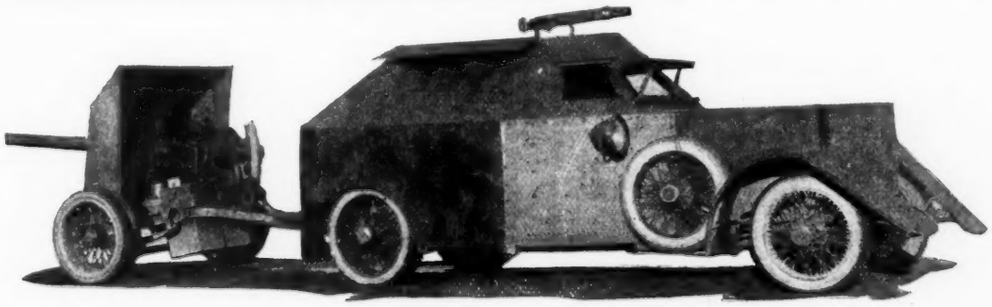
In December, 1914, it was stated that every type of motor vehicle seemed to have been thought suitable for receiving a gun and some armor plating, on the one hand being the traveling German fortresses standing 9 or 10 ft. high and probably weighing 8 or 9 tons and on the other hand ordinary touring cars with a quick-firing gun back of the rear seat and entirely devoid of plating. Two types of armored cars seemed really desirable at this time, the first was a powerful touring car or 2-ton truck chassis well armored without being too heavy, somewhat like the Belgian cars already described. The total height of such a car should not exceed 60 in., the driver being close to the center of the single compartment and the steering wheel raked to make his seat low. Motor and radiator should be completely protected, but wheels need not be inclosed, detachable types being an absolute necessity. Differential locks should be fitted, the second type of serviceable armored car was held to be a very light car of the Ford class with a minimum amount of plating, the object of these cars being to extend the scope of machine guns attached to cavalry and infantry regiments.

Most high grade automobiles with four-cylinder motors of 4 by 6-in. bore and stroke have proved satisfactory for armored car work. With an adequate front radiator and good capacity trunk, overheating troubles are not experienced despite the plating. On many cars a reduction of the gear ratio has been the only mechanical change, double steering is a refinement though not always adopted. A machine gun and sometimes a 1-in. gun in addition comprise the armament of these cars, usually mounted in a turret which protects the gunners. Best results have been obtained when these cars worked together in squadrons.

Some Practical Armored Cars

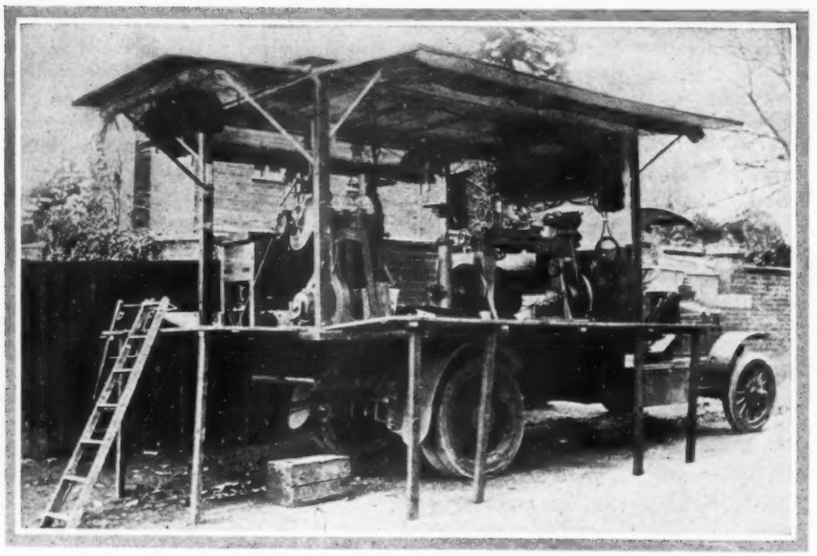
The Belgian armored cars which won great renown in the campaign of Northern France were built up from powerful touring car chassis fitted with machine guns and armor plating consisting of steel not less than 5 mm. thick, the gun being pivoted in the center of the single compartment. In some places a revolving turret was fitted while others merely had a shield in front of the gun and revolving with it. The driver occupied the most central position in the machine and was practically immune from attack. He had a view straight ahead through a hinged shutter and in addition had a small port on the right, level with his head.

The Renault company built a number of armored cars for the French Government at the end of 1914. The chassis was the Renault 18-hp. model having a four-cylinder motor, 3.7 by 6.3-in. bore and stroke and detachable wood wheels with pneumatic tires, twin wheels being used at the rear. Armor plating protected the entire car with the exception of the tires and wheels. The method of construction was to place steel ribs at wide intervals from frame member to frame member above the motor and as far back as the steering wheel. Steel plates were attached to this framework by means of bolts and wing nuts, so that any plate could be quickly dismounted to get at the mechanism, both motor and radiator being completely covered. A steel plate was carried at the extreme front between the



Above—Motor buses transporting troops drawn up behind the French lines

Right — Rolls-Royce armored car which hauls a naval gun on a special twin-tired chassis



One of the automobile repair shops which help to keep the cars and trucks with the French and British armies in condition

frame members to protect the underpan which with this system of cooling must be completely air-tight to prevent the draft passing otherwise than through the radiator tubes. At the rear there was a similar plate protecting the axle and differential housing. The body was a box-like structure with a quick-firing gun pivoted in the center and having a rectangular shield. The steering column was raked to give the driver a low position.

Overloading a Frequent Fault

A common fault in the construction of armored cars was the loading down of a touring car or light truck chassis with armor and guns too heavy for its capacity. This was especially the case where naval engineers were responsible for the construction, an example of this being a Pierce-Arrow 5-ton chassis on which was placed a big bed plate mounted on heavy I-beams, 1 ft. apart and carrying a 6-lb. gun which brought the weight of the gun and mounting assembly up to 5 tons, the armor plating weighing between 3½ and 4 tons. In addition, ammunitions, stores, supplies, and accessories had to be carried. This truck without full equipment weighed 4 tons. There were a fleet of trucks built in this way and each one developed trouble of some kind. All the springs flattened; one car had a 1¼-in. twist in every universal back of the gearbox and the main shaft was sprung ⅛ in. so that it was impossible to move first or reverse gears without a heavy hammer. Before the car could go into service it was necessary to cut away sufficient unnecessary metal to reduce the weight to a reasonable quantity.

Four-wheel-drive early in the war proved its value for armored car purposes, since such a machine driven and steered at both ends would be capable of traveling over any country and of high speed on good roads. It would also be able to get out of difficulties at a rapid pace from which it would otherwise be inextricable. Four speeds forward and two reverse were mentioned at this time as being desirable for these vehicles.

Four-wheel-drive tractors also found favor with the artillery service early in the war, these vehicles being found much more efficient and serviceable than horses for hauling guns and for bringing up ammunition.

The French artillery was greatly strengthened by heavy guns mounted on special chassis fitted with four solid struts capable of lifting the wheels from the ground and thus providing a solid platform. Many of the 155 mm. guns were drawn by four-wheel-drive tractors instead of horses. After the guns were in position the tractors were run into shelter the same as horses, being more easily concealed, however, and also having the advantage of being able to haul the guns out of a difficult position without actually exposing themselves. The French made a light four-wheel-drive tractor in large numbers which was designed to pull a useful load of 6 tons. These vehicles were found very useful.

Mounting the 75 Mm. Gun

The lighter Peugeot high speed chassis fitted with double steering gears, so that the driver could face either front or rear, a couple of reverse gears and two quick firing guns and adequate armor protection was later adapted by the French army to its artillery work.

Later, the 75 mm. gun was extensively mounted on 30 hp. chassis, a pivot carried on the steel platform and bolted to the frame members carrying the gun, at the left side of which the gunner's seat was attached. When brought into action the chassis was raised from the ground sufficiently to remove all weight from the springs but not to lift the road wheels, this raising being done by four hydraulic jacks, one at each corner of the chassis and simultaneously operated.

There appear to be no four-wheel-drive tractors in Italy, but heavy gasoline tractors for hauling heavy artillery are produced in considerable numbers, these vehicles being designed primarily to operate away from made roads. The Fiat chain-driven 70-hp. tractor is an excellent example and is fitted with a caterpillar band attached to the driving wheels which can be used for traveling across rough country.

A number of special army trucks such as searchlight and wireless telegraphy cars are now being produced while armored cars with 5 mm. plating and generally fitted with two machine guns are manufactured in moderately large quantities.

A French ambulance fording a stream while carrying wounded to the field hospital. Note the dual rear tires and the flat fenders

Standards for Aircraft

Work Done by S. A. E. and Success Thereof Brings Existing Standards Into Aviation Field—Need for Special Air Standards

By Henry Souther
Past President of the Society; First Chairman S. A. E. Standards Committee

AFTER getting away from active participation in the work and looking at it from the standpoint of an observer on the side lines, and as an executive in a manufacturing firm using S. A. E. standards, I am glad that some work of the kind was done by our S. A. E. standards committee. Much use is being made of the standards and much confusion and waste of money have been avoided; of this I am certain from personal observation. The gap existing between these two limits is very wide, when measured in dollars and cents.

Eliminating Waste

As an executive it was a great comfort to feel that a lot of time and money was not being wasted in the drafting room by some ambitious young draftsman in the design of a new screw thread, a new spark plug thread, or a new lock washer. A general order to the engineering department to adhere closely to S. A. E. standards was easily obeyed by the engineering force. Departure from S. A. E. standards was very rarely necessary.

I am sure S. A. E. data books are a success in this matter. The information is quickly available, thanks to the untiring efforts of the manager and his force at S. A. E. headquarters. It is a great pleasure to hear in many quarters the commonplace nomenclature adopted by the S. A. E. standards committee in the naming of the many qualities of special steels used. Producer and consumer now talk the same language when steels are mentioned. The consumer knows how to ask for them and the producer knows how to furnish the desired quality without argument or unnecessary correspondence.

Saves Drafting Time

It is much easier for the designer to lay down a tube section, an angle or channel section, or other standard shape, with an exact detail drawing to follow, than to work up something original. It is vastly easier for the producer to furnish a standard stock size than to make something special.

This all seems platitudinous; but there are a few who have not learned it yet. Such consumers must be lacking in common sense.

The old bugaboo of throttling originality has evaporated. Progress in the art has been rapid, in spite of the money saved by the use of S. A. E. standards. It is fair to assume that some of the money saved has been spent to advance the art even more rapidly.

Just now my attention is focussed on the development of the aeroplane. The observations of a few days show that S. A. E. standards are playing an important part. They creep naturally into the detail of design. They are natural standards. The engineering detail has stood the criticism of many minds. The producer has approved, and so has the consumer. Nearly every objection was eliminated at the outset. The result is as good as may be, and the airship designer is quick to see this. It is plain that similar work in making standards is to be done in airships. A preliminary glance shows that certain parts of all air machines should be the same. Propeller hubs, spark plugs, screw threads for turnbuckles and end connections for wire cables are a few examples.

It is plain, also, that this new industry is to be a real one in this country. The progress made is far beyond that realized by the public; even the engineering public, who should be best informed.

Schools Give Fundamentals

Our technical schools have courses of instruction that are teaching the fundamentals in a very practical manner. The students are not all youngsters, but are the business men, engineers and flyers who are pioneering the industry. The result is many good air-planes and many good engines. The term good is used in reference to the age of the art. The art is young and the product no more 100 per cent good than was the product in the automobile art 10 years ago.

It is fair to assume the same rapid progress in the new art. Airships are practically new; they will come into use more and more rapidly, just as the motor car did.

Will Help New Work

I hope to play some part in developing the new standards. It is natural to assume that, inasmuch as the United States will be a large consumer of airships, army and navy engineers will be active in establishing standards for the new fighting arm. Such co-operation with all concerned will make progress very rapid.

Consumer and producer have learned to get together in one art; surely it will not be hard for them to do so again.

Library Extension by Volunteer Service for Aid in Research

A Proposition Dedicated to the S. A. E. and Addressed to the Library Authorities Throughout the United States

By Marius C. Krarup

SOME librarians have a surprising amount of information in different branches of knowledge, as well as a "nose" for quality in books, enabling them to make excellent selections from the book market and from collections which come under the hammer. Requests for certain books from patrons of the library probably help or hinder in each case, according to the liberality of the budget for purchases and the average information of the patrons. But, on the whole, librarians cannot be specialists in any branch, and the public value of the library must depend mostly upon its *completeness* in the branches it aims to cover. On this basis there are few, if any, libraries in the United States which are well enough stocked for the research work of specialists. The information wanted is too often in books which are not on hand. Only the modern resumption of the good old habit of citing all sources of information in scientific books helps out somewhat. But it does not produce the cited book, which may be wanted.

In addition to the scarcity of good libraries, their local character curtails their usefulness. To get the full benefit of them, one must be on the spot. Chicago's libraries are mainly for Chicagoans, Boston's for Bostonians, that of the Case School for Clevelanders, and the New York Public Library as well the library of the United Engineering Societies mainly for New Yorkers and visitors to New York.

The idea that such a policy may be deliberately maintained for the purpose of drawing visitors to the city where the library is located, can probably be dismissed without comment. The spirit of library boards is broader.

Now, apart from the bulk of work done by visitors, quite a bit of research work is done in these libraries, or in some of them, through the employees, but the requests come principally from persons living in the same city, who shrink from doing the work themselves, because they are unfamiliar with it or cannot spare the time. This is excellent, so far as it goes, but the library can usually not hire more assistants than needed for routine work, and these cannot as a rule be competent beyond a mere word knowledge in any specialty. Knowledge of foreign languages is merely literary, and seldom that. Both quantity and quality of the requested work must suffer. The greatest curtailment of library utility comes, however, in the work which is neither done nor requested, because the facilities for having it done well or at all are not on hand, and because the public within as well as outside of the library city are not aware that anything of the kind might be arranged. Occasionally a physician or engineer living in a provincial town commissions a friend living in a library city to look up a subject for him, but, on the whole, *no conception of the large libraries as national stores of information which may be drawn upon from any part of the United States, under a regular routine system involving moderate fees for competent work, has been cultivated or exists.* This although the general system of library arrangement and extension work within the home community is more advanced in other respects in the United States than in most other countries.

The writer remembers from the period 1873 to 1882, during which he occasionally frequented the Royal and the University libraries in Copenhagen, Denmark, that the chief librarian at one or the other of these large institutions sometimes received requests for research work to be done for pay and that he commissioned competent outsiders who were willing to do this class of work to come and do it at the library; in most cases on a time basis for the compensation, I believe. Whether he had a list of such men or merely picked them from his circle of personal acquaintances in each instance, I do not know. This vague recollection prompts the suggestion that the same thing may be done here on a much larger scale, as a perfectly regular feature in library activities and one entitled to frequent and free mention in the newspapers.

Though not highly competent in this matter, I must for the sake of completeness outline the kind of service contemplated.

A good-sized room in the library set aside for the Volunteer Extension Service, in the charge of the second or third assistant librarian.

A corps of workers, graduates from universities or equivalent institutions, each worker having some broad specialty and being indorsed with regard to character as well as competence; those from foreign countries and institutions being provided especially with consular attestations; all of unobjectionable personal habits. The list secured by advertising; its members to qualify to the library board.

The services of these volunteers or examiners for research work to be obtainable on call by mail or telephone, with preference for those, among equally qualified, who can respond most promptly. Evening work permitted, even at late hours, in order to have a good selection of men. Women only on perfectly equal terms of qualification. Compensation on a time schedule, with registry of time for coming and going at library upon the service card for each job. In cities with more than one library, co-operation in service cards and registry.

A number of typewriter machines at disposal in the room set aside for this work. A list of operators obtainable on call. One or two of them constantly on hand, the list taking turns at full day and full evening service. Their compensation on a time schedule, for each job, even on days when whole time is required, the assumption being that the time on these days will be fully engaged, while the necessity is the avoidance of any incalculable special expense for the libraries.

The uniform charge may be composed of $1.00 per hour to the examiner, 40 cents per hour to the typist who transcribes his dictation, notes or selected passages from books and 10 cents to the library for each hour of examiner's time. For rush work or when translations render such disposal expedient, more than one examiner and more than one typist may be employed for a job. Each request for research must be accompanied by cheque or postal order for $25, the unused balance of which is returned to the sender by library cheque. If work cannot be completed within this sum, sender is notified, and he must send another cheque for $25.

When request is received, blank is mailed the sender, specifying the rate of charges and the methods used, and this must be mailed back to library with the subject for the desired research clearly stated and limited. The need for translation must be stated in order to have it done. In default thereof, foreign language is merely transcribed.

When the research work is finished and transcribed, it is mailed to the client with filled-in blank stating number of examiner, his qualifications, number of hours used by each worker, attestation that examiner has verified the work of the typist, and giving a complete list of the works (with edition and year of publication) which have been examined, including not only those mentioned in the research record but also those from which no results have been obtained.

For photographs (by photostatic or similar process) done from books or plates upon request of examiner, a special charge of 25 cents for each is made, including the white-on-black negative. An apparatus for this work shall be at disposal, but may be shared with library at large.

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Such or similar might be the plan by which thousands of professional men, newspaper men and business firms could become affiliated with the libraries of the large cities in the matter of acquiring knowledge which they may need and which they now usually acquire less promptly, in less reliable form, more expensively or not at all.

So far as members of the S. A. E. are concerned, it is by no means the idea to suggest that any considerable amount of research among books and periodicals usually comes within their province or would be profitable. On the contrary, their interest can be enlisted for the plan mostly because, in their case, it could occasionally save their own individual time, while giving them nearly the same security to the effect that nothing has been overlooked—in patent records or earlier developments akin to the subject in which they are interested—as they could obtain by laborious personal research.

Paragraphs on Current Topics

By Marius C. Krarup

Motto: Radical Thought, Conservative Action

Weather and time-tables, swashing waves and shady stoops begin to assert their silly rights of temporary precedence over gears and uncomfortable calculus. Cooling by splash and lubrication by syphon begin to look rational. Single-cylinder headgears are in dead storage. The season of frivoling is on. It is to be formally opened next week, when fortunate members of the S. A. E. are to try once more to reach the shores of Georgian Bay by skilful navigation and such jettison of accumulated loads of learning as may be found necessary and practicable.

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This joyous event throws its shadow beforehand over these topics. War echoes, gasoline prices, the dust of the road, the overhauling of the old motor boat, Preparedness in all its five senses (each more important than the other), the results of the races, our new hopes in aeronautics—all these subjects receive a new coloring through the stupendous amount of pessimistic philosophy which the S. A. E. excursion stirs up in the breasts of members who can't go. What would become of the automobile industry, for example, if Lake Huron were infested with the tin sharks of the North Sea; nay, if a single U-boat had been dropped into the lake (through diplomatic channels of course) and were to direct its devilish aim at the precious ship carrying most of our hopes of progress? This dread thought alone may account for many cautious absentees.

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This raises the question: Why do automobile engineers go junketing by sea or lake, instead of sticking to their own professional element, which we believe is an equable mechanical mixture of gasoline vapor, road dust, curves and equations? An authoritative answer is fortunately at hand. It comes in several sections. They could not get to Georgian Bay by car in a straight line, and any other is abhorrent to engineers. They could not get back in time. They might be commandeered in Canada. They would have to go one engineer in each car, as nobody would want to advertise or indorse the more or less erratic product of his less clear-sighted colleague. Furthermore, they are, each and all, 90 per cent human and only 5 per cent engineer, the remaining 5 per cent being made up of variable impurities which defy chemical analysis, but in which all sorts of special abilities are said to reside.

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Additional reasons can be mentioned: With regard to gasoline, Standard Oil continues to offer substantial prizes for operative economy with this commodity, and the engineers are not out for economy on this trip. They are out to forget gasoline and dust, to give the 90 per cent human a needed airing and to work all the rest into a stable emulsion of fraternal sentiment in which no conflicting interests can be distinguished; for they have discovered that Fraternity is now the only one of the revolutionary trio whose gilt remains untarnished, while Liberty and Equality look much the worse for wear and tear.

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No doubt, from the clear atmosphere on board the ship a few thoughts will revert to the dust which has been left behind. Unlike Dr. Guglielmini and Pierre Giffard we always carefully dodge this subject. It is unflattering to our resourcefulness. Dust—to be cussed! That is about all you can do with it at less than five to sixteen dollars per square yard of road surface. But, of course this is only because the S. A. E. has nothing to do with road engineering. May the thought come to them to take it up; to form an S. A. E. division of civil engineers or a road division within the S. A. E. Since the road is recognized as the other half of the automobile, the subject should lie at least as close to interest and duty as Industrial Preparedness. And Pp is getting as common as π with automobile engineers. No, it does not stand for preposterous propensities, but for prosperity and preparedness.

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In another direction the influence of the automobile engineer seems to have been too strong. Because racing motors were taken out of the automobile and put in the motor boat, the four-cycle type of motor has predominated in boats ever since. Is this again because there is no influence among motor boat constructors comparable to the discriminating and yet unifying effect of S. A. E. work? The opportunity for developing the two-cycle motor to equal perfection with the four-cycle motor under the most favorable conditions is identified with boats, and if this natural bent had been followed, we might now have had twin-cycle twin-twelves, which in turn might have become useful for automobiles and aeroplanes. How about a motor boat division of the S. A. E.?

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If cars were faster than their drivers at Indianapolis, as on ordinary roads, while the drivers were faster than the cars on the smooth Sheepshead speedway, a superlative spring suspension seems to be the next logical demand for racing cars.

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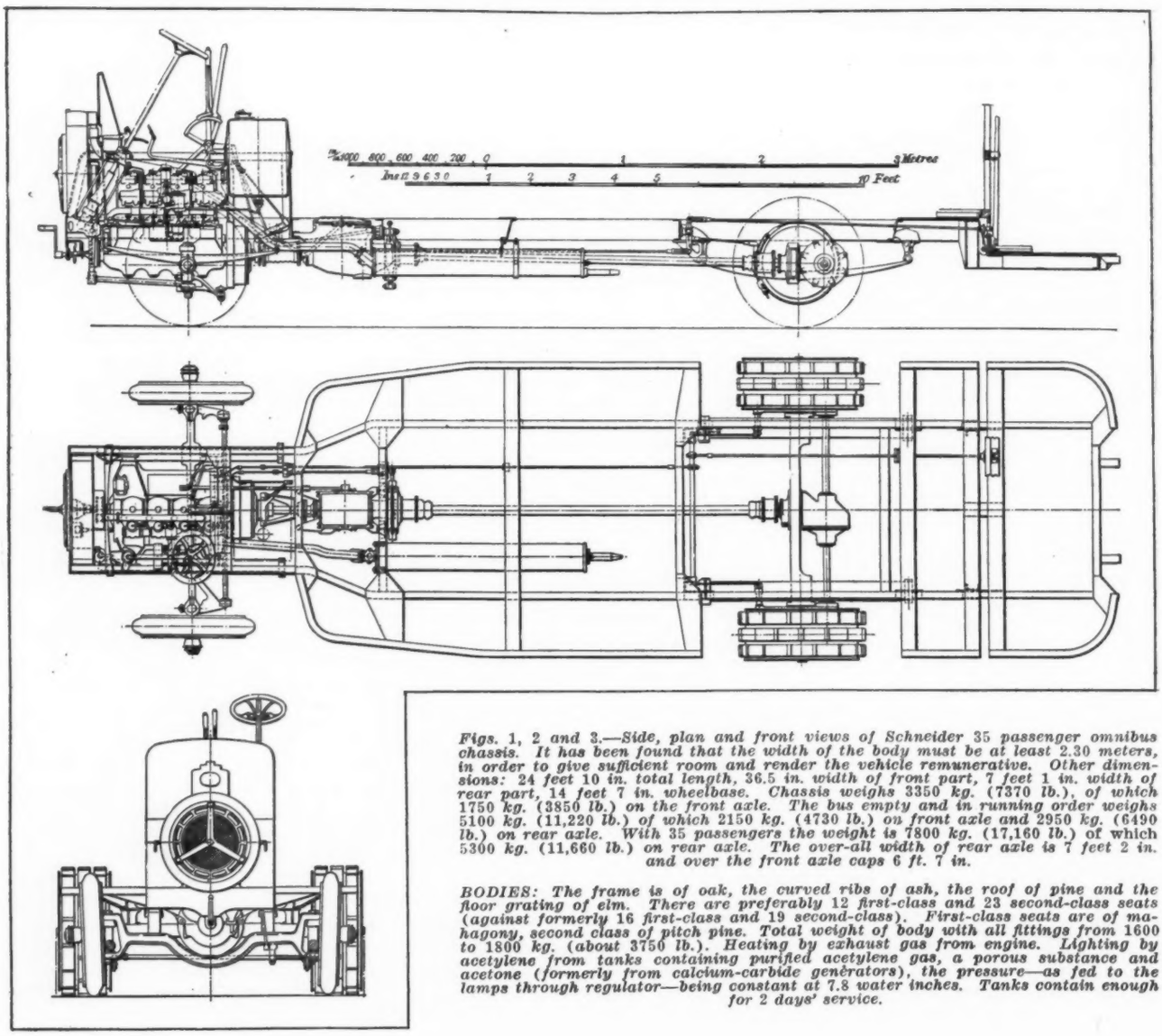
That aeroplanes are mostly shot down these bellicose days, makes us forget perhaps—the president of the Aero Club says they are now safe—that they can still come down for less complimentary reasons, and do. Scarcely too safe for sport, as yet, they should be meat for S. A. E.

Omnibus Construction Graduated from Both Peace and War Service

WHEN a few months ago the Paris General Omnibus Company decided to resume on a small scale the service which had been interrupted at the outbreak of the European war, it was held that the best thing to do in the matter of design and construction was to duplicate the type of vehicle which had been finally adopted in the middle of 1914, just before the company's entire equipment was commandeered for use in the military operations. Many new vehicles were built on this plan, but they did not go into commission in the streets, as the army continues to take them as fast as they are turned out. The indorsement which this type has received through its success as a money-maker in the public transportation system of Paris and subsequently through the satisfaction derived from the use of the chassis for very rough war service, lends special interest to a study of their construction and, actuated from this point of view, *Engineering* (of London) presents a number of scale drawings representing the main features in the Schneider chassis and body and also the principal varying features in the De Dion chassis, which is used to a more limited extent. These drawings are reproduced in the following, with brief explanatory captions, but the reader is likely to find, according to his own needs and experience, special points of interest in each drawing which are left unmentioned.

These omnibuses are the result of a practical evolution which had reached the stage at the beginning of hostilities that breakdowns had ceased to occur, expenditure was on the decrease and receipts were rising. The population favored the buses more and more in competition with the underground service, and neither the comparatively heavy gradients of Paris streets, nor the short routes rarely exceedingly 4.3 miles in length and necessitating considerable waste of time at the termini, prevented satisfactory financial returns to the operating company.



Figs. 1, 2 and 3.—Side, plan and front views of Schneider 35 passenger omnibus chassis. It has been found that the width of the body must be at least 2.30 meters, in order to give sufficient room and render the vehicle remunerative. Other dimensions: 24 feet 10 in. total length, 36.5 in. width of front part, 7 feet 1 in. width of rear part, 14 feet 7 in. wheelbase. Chassis weighs 3350 kg. (7370 lb.), of which 1750 kg. (3850 lb.) on the front axle. The bus empty and in running order weighs 5100 kg. (11,220 lb.) of which 2150 kg. (4730 lb.) on front axle and 2950 kg. (6490 lb.) on rear axle. With 35 passengers the weight is 7800 kg. (17,160 lb.) of which 5300 kg. (11,660 lb.) on rear axle. The over-all width of rear axle is 7 feet 2 in. and over the front axle caps 6 ft. 7 in.

BODIES: The frame is of oak, the curved ribs of ash, the roof of pine and the floor grating of elm. There are preferably 12 first-class and 23 second-class seats (against formerly 16 first-class and 19 second-class). First-class seats are of mahagony, second class of pitch pine. Total weight of body with all fittings from 1600 to 1800 kg. (about 3750 lb.). Heating by exhaust gas from engine. Lighting by acetylene from tanks containing purified acetylene gas, a porous substance and acetone (formerly from calcium-carbide generators), the pressure—as fed to the lamps through regulator—being constant at 7.8 water inches. Tanks contain enough for 2 days' service.

Many of the buses taken over by the war department were, after the first rush, returned to Paris from the war zone, and their bodies were converted with the object of further facilitating the transport of men and foodstuffs. For the commissary service, the whole of the seating accommodation was removed, the glass panes were replaced by wire netting and strong hooks were secured in the roofs. Some of the new-built vehicles were equipped in the same manner.

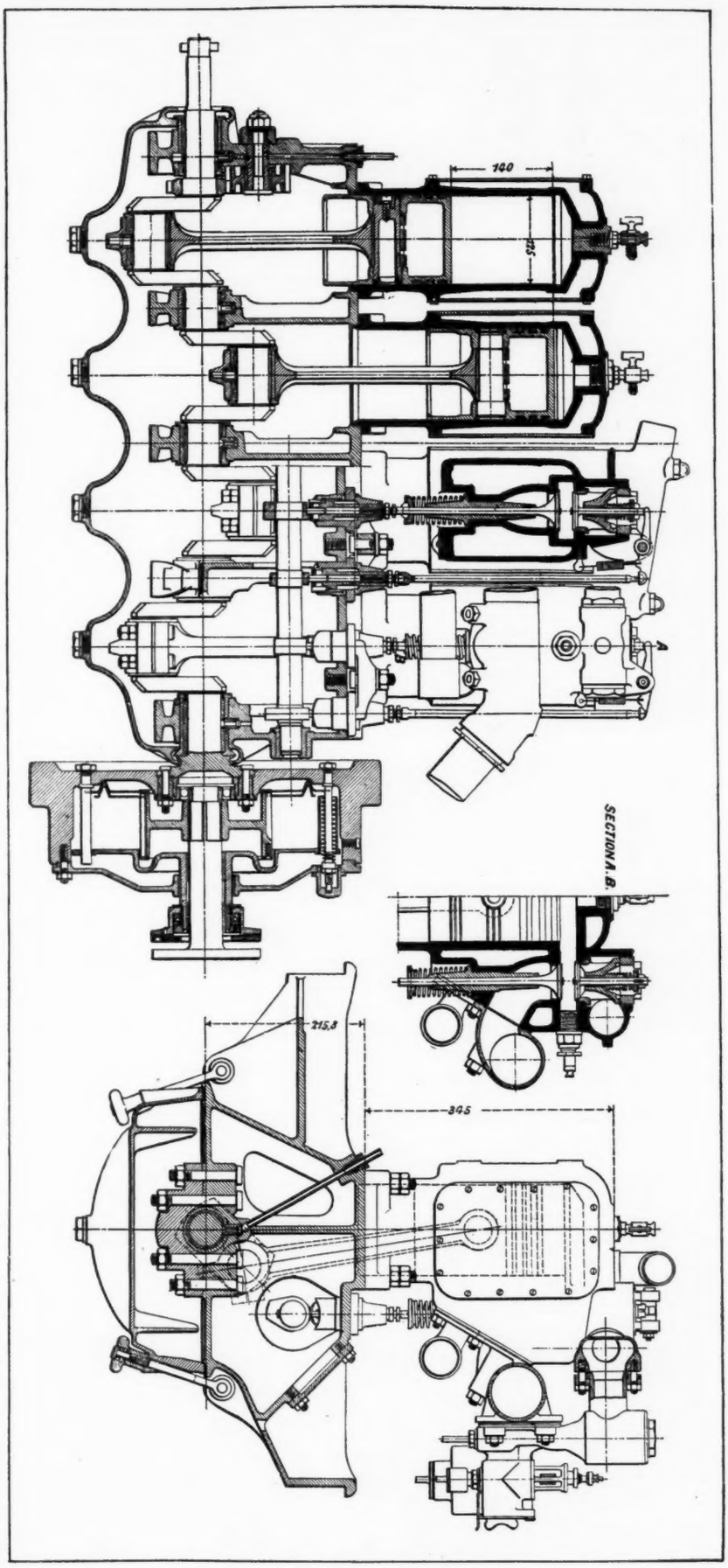
Earlier Developments

Prior to 1906 a number of double-decked buses were in use, but they have been gradually discarded, mostly owing to the delays caused by passengers taking their time when entering or leaving. An otherwise satisfactory bus of this class carried thirty-two passengers and was mounted on a Schneider chassis. The four-cylinder Schneider motor, with bores of 4.9 and stroke 5.5 in., developed 30 hp. at 900 r.p.m. The chassis weighed 3190 kg. (7018 lb.), of which 1690 kg. (3718 lb.) was on the front axle. The empty omnibus weighed 5060 kg. (11,132 lb.) with 2030 kg. (4576 lb.) on the front axle. With all seats occupied the weight came to 7270 kg. (15,994 lb.) and the maximum speed on the level was 13.7 m.p.h. Second speed was 8.1, and low was 4.05 m.p.h. The same type was built to thirty-four passengers, while engine and vehicle speeds were slightly increased, becoming the same that are now used; namely, 1000 r.p.m. and 14, 7.9 and 4.05 m.p.h. On the whole this became the prototype for the present model, by removal of roof seats and lengthening of the chassis, a platform built of angle bars being added. Many of these remodeled vehicles are among those still in service.

Other types which were tried and discarded were: One seating twenty-three passengers longitudinally; one with twenty-one seats and wheels shod with pneumatic tires those on the rear wheels being treble; one seating twenty-eight with side entrance close to rear end; one seating thirty with rear platform on a lower level and reached by a step on center line of vehicle.

Heating

The buses are heated with the exhaust from the engine, for which purpose these gases are piped



Figs. 4, 5 and 6—Sectional views of engine for 35-passenger Schneider omnibuses. The four-cylinder engine is carried by two cross-members. The cylinders are of the L-type and lubricated by splash. Bore 4.9 in., stroke 5.5 in., as in earlier type before referred to. Camshaft has keyed-on cams and is gear-driven. Inlet valves operated by long tappets and exhaust valves by overhead rockers. Ignition by high-tension magneto. Cooling by thermo-syphon, with radiator and fan on front of chassis. Aluminum three-armed spider protects copper tubes of radiator. Power transmitted by Hele-Shaw clutch in flywheel.

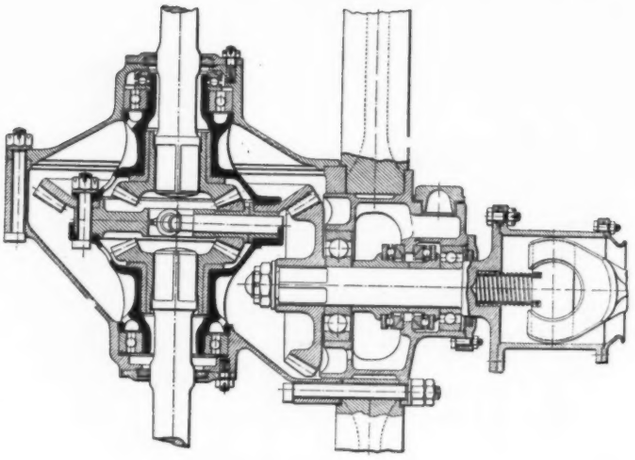
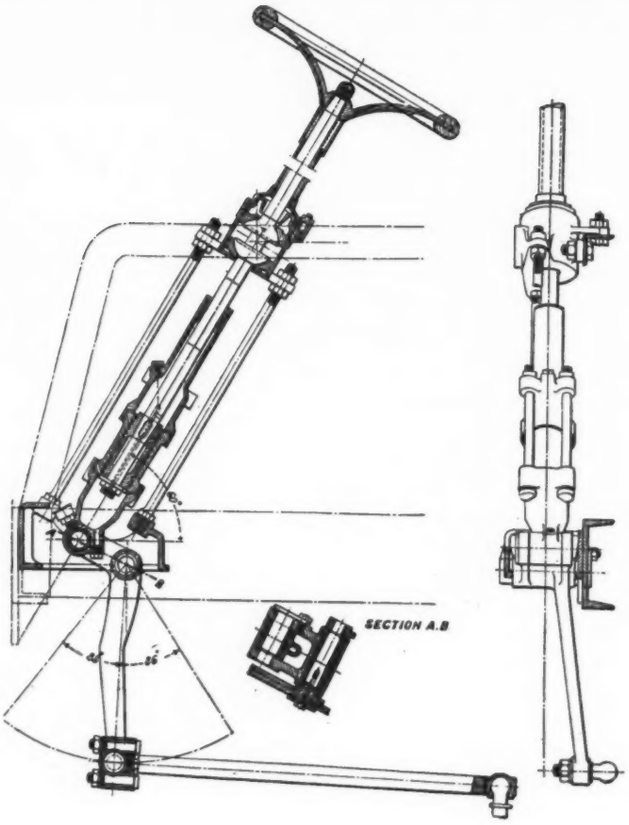


Fig. 7—Shaft drive with universal, bevel gear and differential gear in Schneider omnibuses, showing also relations to the load-carrying axle and wheel shafts to final gear reduction by annular spur gear drive in the rear wheels, the latter parts being shown in Fig. 13. The vehicle has two brakes; a transmission brake actuated by a pedal which also disengages the clutch, and a rear wheel lever brake.



Figs. 8, 9 and 10—The Schneider steering-gear. It is of the screw and nut type and on the left side of the vehicle on the outer side of the frame members. (Figs. 1, 2 and 3 show it on the inside of the frame and also in other respects seem to represent the chassis of a remodeled double-decked omnibus rather than the final type, showing, for example, treble-tired rear wheels though final type has only twin tires.) The front wheels, which have single rubber tires, are 35.4 in. in diameter.

through aluminum foot-warmers, and baffle plates in the pipes in conjunction with a butterfly valve in the muffler serve to regulate the temperature in each heating unit. But these foot-warmers have not always been found perfectly gas-tight.

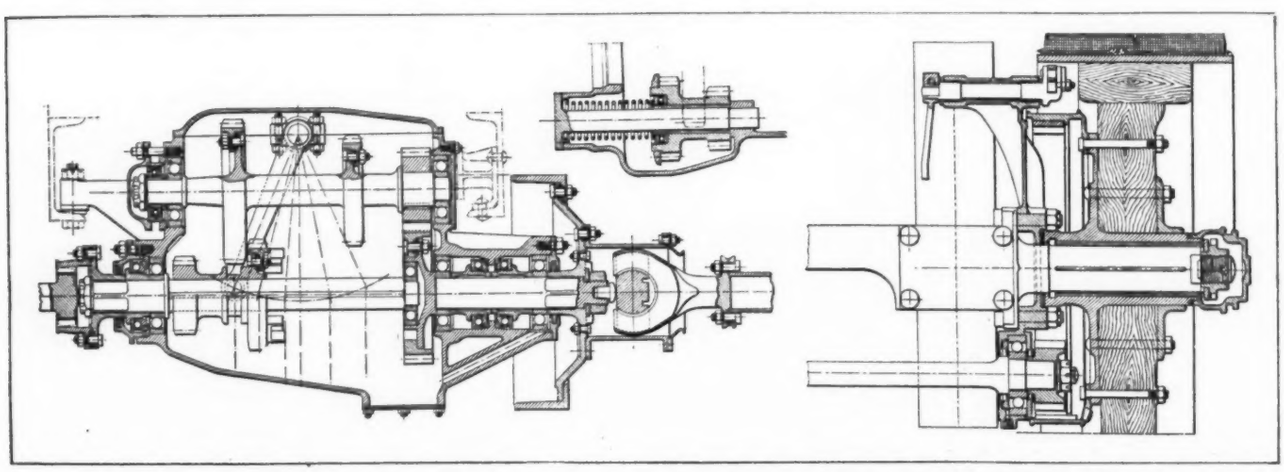
The 31-Passenger De Dion-Bouton Omnibus

In the development referred to above it was found most profitable to use vehicles of slightly smaller size for the shortest routes; and these were built on De Dion-Bouton chassis at Puteaux, near Paris. The frame is 22 ft. 8 in. long, 37.2 in. wide in front and 7 ft. 1 in. at the rear, while the total width over front axle caps is 7 ft. and over rear axle caps 7 ft. 4½ in. The body width in front is 6 ft. 3 in. and at the rear 7 ft. 4 in. The wheelbase is 11 ft. 8 in. The wheels have the same diameter as those of the Schneider chassis. The weight is 3470 kg. (7634 lb.) of which 1770 kg. (3894 lb.) is carried on the front axle. The whole vehicle empty and ready for service weighs 5070 kg. (11,154 lb.) with 3100 kg. on the rear axle. With thirty-one passengers the weight comes to 7160 kg. (15,752 lb.) and the front axle load to 2085 kg. (4587 lb.). The speeds on the level, with the motor at 1000 r.p.m., are 12.4, 6.85 and 3.75 m.p.h.

The accompanying illustrations, Figs. 14, 15, 16 and 17, show the most important details in which these omnibuses differ from the 35-passenger Schneider omnibuses.

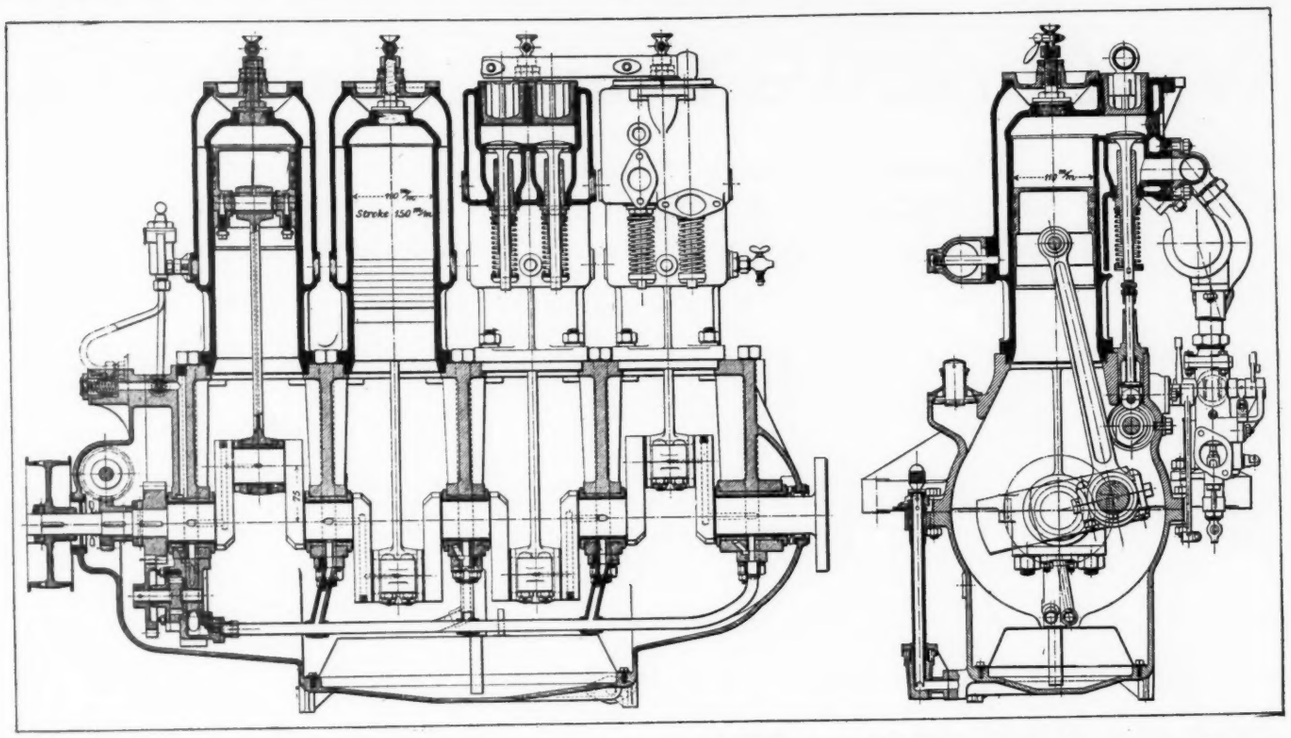
Maintenance of Paris Omnibuses

When the omnibuses were in city service, they were inspected by a mechanic at each terminus of routes and every



Figs. 11 and 12—The speed gear box of Schneider chassis, mounted between two transverse frame members and connected by universals at front and rear ends of lower shaft. Three forward speeds and reverse (Fig. 12). Transmission brake of large diameter, internal expansion type. All universal housings metallic; leather discarded.

Fig. 13—Rear wheel of Schneider chassis, with spur-gear drive, brake drum and one-piece twin tire. Diameter 37.4 in. The shoes of the brake are wood-lined. The wheels are of wood and manufactured at the omnibus company's works; the spokes of acacia; the rim of elm; the naves of steel with phosphor-bronze bushes.



Figs. 14 and 15—Four-cylinder, 30-hp. engine in De Dion-Bouton 31-seat omnibuses. It is placed beneath the driver's seat. Bore and stroke are 4.3 and 5.9 in., respectively. Normal speed 1000 r.p.m. Ignition by high-tension magneto, without adjustment for timing the spark. Carbureter is of double-jet type. Control by accelerator pedal. Engine speed limited by governor. Cylinders are fired 1, 3, 4, 2. Cooling by thermo-syphon. Lubrication forced. Radiator similar to that in 35-seat vehicle. The plate clutch is of the De Dion type. The engine is mounted in a cradle resting at 3 points in cross members of the frame. Three forward speeds, direct on third, and reverse. Steering by worm and segment, irreversible. Transmission brake and rear wheel brakes similar to those on Schneider chassis. The front axle is a one-piece drop forging.

night at the garage. After working 25,000 miles each vehicle was taken to the shops and overhauled, the body being first removed; all loose rivets were replaced. The whole working mechanism was taken apart, re-adjusted and tested.

Cost items under this plan were found distributed as follows: .13 franc per kilometer for chassis and motor; .03 franc for the body; .12 franc for tires; .0265 franc for washing, lighting and heating; .2125 franc for fuel.

The fuel was at first an equal mixture of benzol and alcohol; later; benzol alone. The consumption was, average, .176 gal. per mile of 90 per cent benzol, density .880; .180 gal. per mile of gasoline, density about .745; .2 gal. per mile for the alcohol-benzol mixture. Lubricant, grease and cotton waste totaled .02 franc per kilometer; driver's wages .10 franc; depot charges .06 franc.

These figures are here given for mutual comparison only, as the radically different cost of labor and materials in France renders all other comparison illusory. The same applies to administration expense. The Paris company collected 426 million fares and 58 million francs in 1913.

Fig. 16—Bevel gear drive and differential on De Dion-Bouton omnibus. The wheel shafts by flexible joints operate spur pinions which engage the internal gear teeth of two rings which are bolted to the wheels, as shown in Fig. 17.

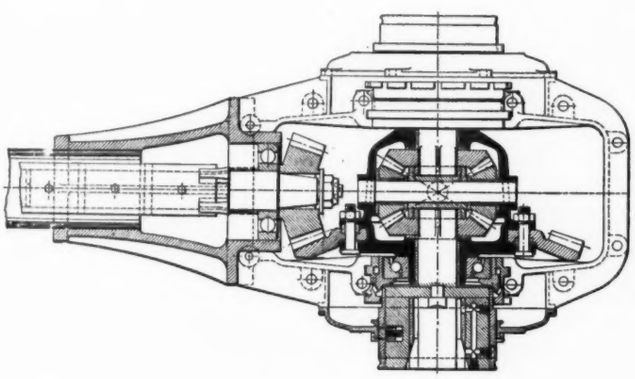
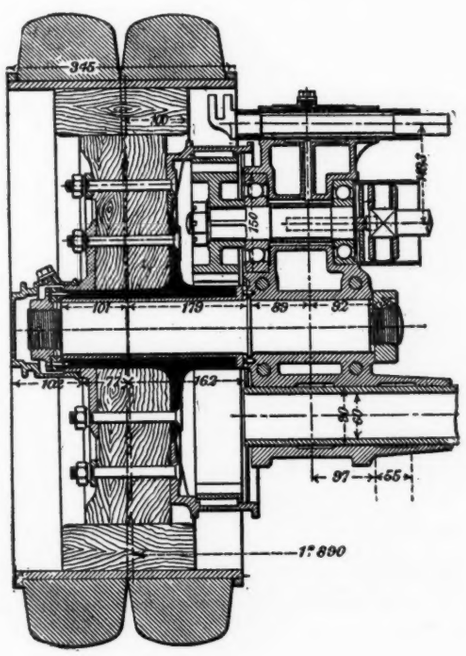


Fig. 17—Rear wheel and axle head of De Dion-Bouton omnibus. The rear axle consists of a tube fitted in two cast-steel axle heads, and the latter are connected to the rear springs.



What Can We Learn from Racing?

Engineering Lessons Derived from Speed Contests Too Valuable To Be Neglected—Manufacturers Must Not Overlook Value of These Tremendous Tests

By J. Edward Schipper

RACING means no more to the automobile industry than baseball, golf or any other form of sport and entertainment if the valuable lessons to be derived from it are not taken to heart. There are just two ways of looking at automobile racing from the standpoint of the industry. First, is racing merely a means of attracting attention to the automobile, a sort of advertisement for its possibilities, as it were, or is it a means of imposing the greatest possible test of strength, endurance and speed in order that from the lessons we learn we can make stock cars that better endure the stresses of every-day usage?

Not a Sales Proposition

The automobile industry is not in a stage where it needs racing or any other form of hippodroming to act as an incentive for car sales. Perhaps this is the underlying reason why factories are not engaged upon the manufacture of speed creations which will be able to win contests on the country's speedways. Rather than build high-priced racing cars, the costs of which must be added to the costs of regular production, they are bending every effort toward the more productive business of reducing output costs.

As a Teacher

With this phase of the situation out of consideration, the other standpoint comes to the fore. The automobile race as an object lesson for the designer, the metal worker and the machinist, is a different proposition. Valuable lessons can be learned on the track which would never be brought to light by the testing dynamometer or by the road test. The stock car will never be a speed creation, but if the parts which fail in speed creations are strengthened in the stock jobs, it is quite certain that the factor of safety and of life of the touring car will be increased.

Watching for Weak Points

The average cost of building a racing car will range between $5,000 and $20,000. This is actual cost of building and there is no profit or overhead figured in with it. It is not uncommon for a car that is racing all around the circuit to carry with it in spare parts alone a supply that is valued at $10,000. Almost enough parts to build an entire new engine and practically a new chassis are necessary in order to make the replacements that become necessary. This great burning up of metal should be watched very carefully by the engineer of the factory, for by watching the parts that fail through weakness and through faulty design he can guard against the same failures in his own standardized product and also may incorporate little features of design which cost no more but which make his car better.

Multi-Valves an Example

Perhaps the most striking lesson from racing is coming in the way of multi-valves. There are at least five manufacturers in this country who have been playing around with four-cylinder motors of four valves to a cylinder. More than one announcement of models of this type can be expected within a few months. Where did the idea develop? In racing. High speeds are necessary on the racing car. It is also extremely necessary to have the power high at these faster rates of travel in order to overcome the enormous wind resistance and also to carry and maintain the speed itself and still have a little in reserve for a spurt. This condition of high speed and high power means that the gas has got to be brought into the cylinder and burned. It must not remain in the intake pipe or allowed to wire draw. Big valves and plenty of them is the answer.

The same condition is beginning to hold true in the passenger car. Speed capabilities are demanded more than ever. The engines are running at higher rotative speeds. At these fast rates of travel, the engine must be efficient and it must be developing high power. The same conditions as in racing obtain all the way through. Hence, wide-awake designers are going very deeply into the merits of the sixteen-valve four for stock work.

Importance of Details

It is not all in basic design that the lessons of the racing car are to be learned. Pick up the little details that are being tried from time to time on the speed creations. The lesson of the pistons is still being watched. Many are on the fence regarding aluminum. In racing the slap at low speeds is not to be contended with, and that renders the situation different. On the other hand the hour-glass shaped design used in some of the racing cars with the piston supports at top and bottom are worthy of consideration. May it not be that the system of piston rings all near the top as used with the iron piston is wrong with aluminum? Rings near the top and bottom are being tried out in many cars and may result in securing the advantages of aluminum without its one disadvantage.

Placing the Plugs

There is much food for thought in the placing of spark plugs. Even in some of the racing cars this has not been given the care that it should have been given. This was shown on one or two cars at Indianapolis this year. It was not the fault of the plugs that they sooted or failed. Placing spark plugs in close proximity to the exhaust where they are away from the cooling influence of the intake and also placing them where they are subjected to the spray of oil that is apt under conditions of high vacuum to shoot past the pistons is a mistake that brings its own penalty. The same conditions may hold true with a touring car, only not anywhere near to such a degree. In a word, a 300-mile race will show plug troubles that are covered in the space of a year on the touring car.

Larger Waterjackets

In no one thing have racing cars improved so much in the last few years as they have in waterjacket spacing. This same lesson can be taken to heart in the stock motor. It is true that an engine which is too cool is inefficient. Every heat unit thrown away through the radiator is lost as far as power is concerned. On the other hand, every part of the motor should be as near the same temperature as possible.

When waterjacket spaces are cut down and skimped, especially around the valves and plugs, the engine is sure to be troublesome. Larger waterjacket spaces gain more for the engine as far as life and all-around satisfaction are concerned than they lose in the way of heat. This trend toward larger jackets is very noticeable in racing cars, where particular care is being used to keep the water around the head of the cylinder, especially where the overhead actions are employed.

Lubrication Problems

Oiling problems are so pronounced in racing cars that it is very doubtful whether the questions of oiling the ordinary passenger car and the racing car are at all parallel. On the other hand, where the touring motor is operated at high speeds the question of proper oil feed is quite important. Of late there has been quite a reverse in racing motors as well as in some of the touring cars as regards cylinder lubrication. The question up to a short time ago was how to get enough oil to the cylinder. It has now become how not to get too much.

With Aluminum Cylinders

With aluminum pistons the problem of how to keep the oil supply to the cylinder walls properly regulated is even more complex. The difficulty lies in the number of conditions under which the car is handled, and the problem of securing proper oil at all speeds and under different load conditions becomes very much like that of carburetion. A variation in feed is really required to handle the work properly even on a touring car. On a racing car the difficulty is so pronounced that a car oiled correctly at Sheepshead Bay will suffer from too much oil at Indianapolis.

A Question of Speed Variation

The reason for this is that on the Sheepshead Bay track the speed is nearly uniform. Here the pressure feed system works beautifully and where splash is used also the amount fed is very close to constant. At Indianapolis when the car reaches the turns the engine is shut down, with the result that the oil has an opportunity to build up, and when the throttle is opened again the combustion chamber is filled with lubricant and consequent carbon. As the car is accelerated, the smoke shoots from the exhaust.

The Touring Car's Problem

The same problem holds true in the touring car, but not nearly to the same extent. If the oil feed could be regulated to each driver, the proposition would be different. As it is, it must be so arranged that under conditions of city driving at low speeds the proper amount of oil must feed as well as at speeds of 50 or more miles an hour. On the track, the low-speed condition does not have to be met to any extent; on the touring car it is becoming very common to drill the pistons with oil holes to relieve the excess of low speeds, and at high speeds the oil is fed freely without having an opportunity to escape to any great degree by the way of the drilled ports.

Closing the Valves

One of the difficulties of high speeds is to obtain positive closing of the valves. In the racing cars the springs have to be so stiff that the power consumed in operating the valves amounts to a considerable factor. With the higher speed motors in the touring car, it is quite certain that this point of valve closure will have to be watched. In one racing car which has had considerable success on the track this year, it takes a pressure of 150 lb. to operate the valve the distance of its lift, which is ⅜ in. In other words, it takes about 56 inch-pounds, or practically 5 foot-pounds, to open one valve.

Preventing Valves from Riding

It is becoming necessary to give a similar amount of thought to the valves in the ordinary stock motor. These are being run at speeds which make it quite possible that the valve will have a tendency to ride. This can only be cured in one of two ways. The springs have got to be made so heavy that they are quick-acting enough to positively close the valve, or the same principle as Delage uses on the new racing cars will have to be employed and the cam so shaped that it not only opens the valves but closes them.

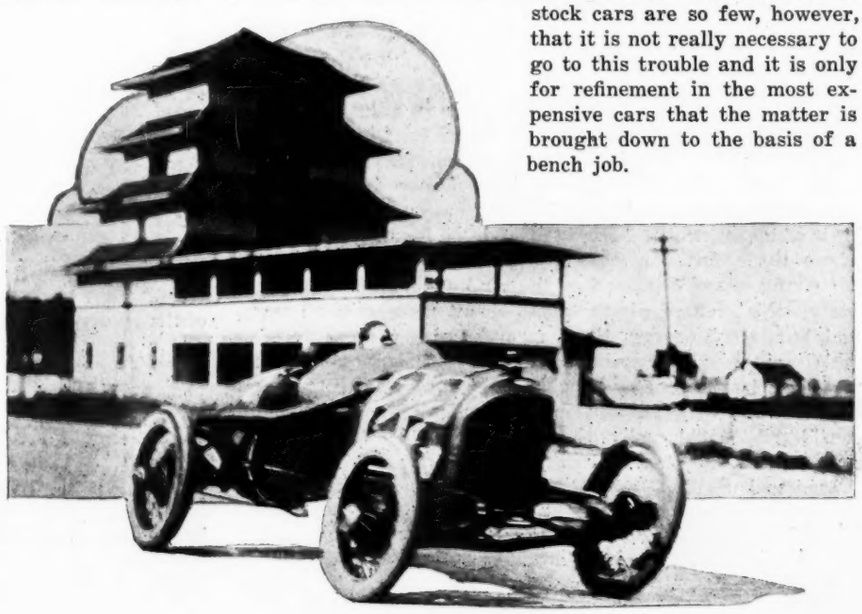
The constant engagement cam is a difficult thing to handle on account of the expansion factor. It has been handled nicely on this Delage type, however, and may act as a hint to some high speed motor manufacturer in this country.

Connecting-Rods Are Important

Connecting-rods are a detail that form an interesting study. At first sight the stresses on a connecting-rod seem to be very simple. When the speed of the motor increases, however, to such a degree that the inertia forces begin to become very high, the stresses on the rod are more complex. It would seem, however, that after all the rod experience the industry has had an almost ideal rod would be worked out by now. Still rod troubles have haunted the Peugeot racing cars and others. Even now one of the engine manufacturers in this country is turning away from the I-beam and adopting the rod of elliptical section. It is difficult to see the reason for this, as the disposition of the metal on the I-beams seems to give the proper section modulus.

Light Parts Are Factors

Rods must be watched on racing cars and touring car manufacturers have to follow their example closer now than ever before, in view of the light reciprocating parts tendency. It is difficult to machine around the bosses at the upper and lower ends of the rods. It means hand work on the racing car, and on at least one expensive stock car hand filing is resorted to on every rod. This is impossible in quantity production and the handling of a good rod when turned out by production methods is a difficult problem. Rod failures in stock cars are so few, however, that it is not really necessary to go to this trouble and it is only for refinement in the most expensive cars that the matter is brought down to the basis of a bench job.



Finding a Figure of Merit

Search for an Ability Formula Is Worldwide—Comparison of Different Efforts Shows Close Correspondence in Results

By John Younger
Chief Engineer Truck Division Pierce-Arrow Motor Car Co.

THERE are many ability formulæ expressing the fundamental functions of a car. They may, however, be divided roughly into two groups, the one showing the physical conditions the car is able to overcome, the other showing its economy in so doing.

The first group contain such formulæ as

Thomas' $$\frac{63000\ Pre}{p \times \frac{D}{2} \times W\left[\frac{20g+R}{2000}\right]} = 1. \quad (1)$$

Roebuck's $$K = 14{,}550\frac{d^2\ s\ n\ r}{D\ W}$$ [Converted from cm. to in. and long tons to lb.] (2)

Roebuck (*The Autocar*, England, June 22, 1912) states:

K should range from
120 to 130 for "de luxe" cars,
100 to 110 for ordinary touring cars,
80 to 90 for trucks.

Thomas' $$Q = 3000\ \frac{d^2\ s\ n\ r}{D\ W} \quad (3)$$

Myer's $$T.\ F. = \frac{7.055\ d^2\ s\ n\ r}{D.\ W.} \quad (4)$$

(S. A. E., June, 1913)

The fifth formula, which is the only one that takes into account values obtained in practical road work, is Thomas' Sigma. (*Automobile Engineer*, England, April 2, 1913.)

$$\Sigma = \frac{.0047\ d^2\ s\ n\ r\ M}{D} \quad (5)$$

In these formulæ
d is diam. of cylinders in inches
s is stroke of cylinders in inches
n is number of cylinders (4-cycle principle)
r is total gear reduction
D is diameter of wheel in inches
W is gross weight of vehicle in pounds
e is mechanical efficiency of transmission
P is Brake Horse Power of engine at *p* revs. per min.
p is revs. per min. at which *P*, hp., is developed
g is percentage gradient
R is Road Resistance in pounds per 2000 lb.
M is average gasoline consumption in miles per gallon.

Let us first consider formulæ 2, 3 and 4. Obviously, they are exactly the same in composition, except that the arbitrary constant *K*, *Q* or *TF* has been chosen differently. *K* was formulated on a basis of metric measurements, *Q* on a basis of inches, whilst *TF* was formulated for use with trucks. These three formulæ represent actual piston displacement per pound moved 1 ft., and on the reasonable assumption that every cubic inch of piston displacement represents so many foot pounds of energy, these formulæ give a measure of a car's ability. The greater the displacement per pound moved 1 ft., the greater should be the car's ability to speed, to climb and to accelerate on the particular gear reduction considered. Incidentally, the greater should be its gasoline consumption, but this we will come to later.

Inasmuch as *K*, *Q* and *TF* are arbitrary constants, there would seem to be no reason why the straightforward $\frac{d^2\ s\ n\ r}{D\ W}$ should not, itself, be used, or perhaps better still the *Q* value, $\frac{3000\ d^2\ s\ n\ r,}{D\ W}$ which represents the actual number of cubic inches piston displacement per pound moved through one foot.

Take now formula (1). This represents what might be called the static condition—the condition of balance, in which the inherent power of the vehicle exactly balances the combined resistances of incline and road surface. This falls into the "ability class," because it represents the practical physical conditions the car will overcome. Suppose we write $\frac{P}{p}$ as "$k\ d^2\ s\ n$" in this formula, we arrive at

$$\frac{63000\ e\ \text{"}k\text{"}\ d^2\ s\ n\ r}{\frac{1}{2}\left[\frac{20\ g+R}{2000}\right] D\ W} = 1.$$

This shows exactly the similarity of (1), (2), (3) and (4), inasmuch as for given conditions of "*g*" and "*R*" there is no difference between any of them.

Take now the Σ value (5), which is $.0047\ \frac{d^2\ s\ n\ r\ M}{D}$. It is obvious that if we take the displacement per pound per foot moved and multiply it by the weight of the car, we get the gross displacement per foot traveled. Multiply this by the theoretically perfect quantity of gasoline that is required to explode in this displacement and you have the perfect value of gasoline used per this displacement.

If, however, you multiply it instead by the average observed, gasoline consumption in miles per gallon, you at once obtain a figure of the car's economy. This is *Sigma*.

We have seen that a car is able to perform better the greater its *K*, *Q* or *F* values, but at the expense of greater gasoline consumed. If, however, we multiply the *K*, *Q* or *F* values by the miles obtained per gallon of gasoline, either in average practice or as obtained by the proposed S. A. E. method, we at once obtain a formula which imposes a penalty at once on either the big *Q* value, or the small *Q* value, and tends to strike an amount which will represent standard good practice.

I would, therefore, strongly recommend that the *Sigma* formula be considered fully, as a necessary rating formula in all cases where gasoline consumptions are measured.

Mr. Thomas, in his original article on *Sigma*, states that probably the best recorded gasoline consumption for straightway road work was that obtained on the R. A. C. officially observed Rolls-Royce car in 1911. The *Sigma* value works out at 4.70, giving a suggestion that an ideal *Sigma* would be about 5. Values are given here for other cars, based on long road work. None of them is for freakish gasoline tests. They are all values such as would be obtained by the ordinary driver over give and take roads.

Rolls-Royce, 50 hp., 1911, R. A. C. trial	4.70
Napier, 60 hp., 1912, R. A. C. trial	4.27
Rolls-Royce, 50 hp., on average roads round Buffalo, 1912	2.60
Mandslay 3-ton truck, 1907, R. A. C. trials	2.70
Pierce-Arrow 5-ton truck in Buffalo service	2.60
Pierce-Arrow 38 in 1912	2.28
Pierce-Arrow 48 in 1912	2.24
Pierce-Arrow 66 in 1912	2.16
Pierce-Arrow 38 on several hundred miles, hilly country, 1912	2.00
Sunbeam 30 on same route at same time	1.69
Pierce-Arrow 66, average of a long tour in California	2.62
Sunbeam, 30 hp., 200-mile run, Buffalo-Toronto and back, 1913	2.20
Pierce-Arrow 2-ton truck in two weeks' N. Y. service	2.57
Pierce-Arrow 5-ton truck on 100-mile good road run	2.91
Ford, 1913 model	3.84
Thomas-Leyland-Delahaye electric transmission truck, R. A. C., observed in 1911	3.56

Digests of S.A.E. Papers To Be Read on S.S. Noronic

Official Abstracts Show the Wide Range of Subjects Covered by the 1916 Program—Many of These Papers Will Be Read Simultaneously—See Program on Page 1048

THE following abstracts of the papers to be given at the S. A. E. summer meeting include all but H. E. Coffin's address, which was not available at the time of going to press. It is understood that this will follow in a general way the talk which he gave recently before the Indiana gathering, which was reported in the last issue of THE AUTOMOBILE.

Possibilities of the Constant Pressure Cycle

By Arthur B. Browne and Herbert Chase

THE authors, having shown that Otto cycle engines possess certain limitations, notably low thermal efficiency and characteristics which render the use of any but highly volatile fuel exceedingly difficult, state their belief that engines of this type must sooner or later give place to others operating on a different cycle.

The advantages and disadvantages of various other cycles are then discussed and it is shown that only constant pressure cycle engines seem to be well suited to the requirements of motor vehicles. The many advantages of constant pressure engines are then set forth as follows:

(1) High M.E.P. with low maximum pressure.
(2) Variable cut-off with constant compression pressure.
(3) Adapability to use of low grade fuels.
(4) Superior scavenging qualities.
(5) Absence of volumetric losses from which Otto cycle engines suffer.
(6) Adaptability to two-stroke cycle.
(7) Lower maximum temperatures.
(8) Absence of complication because no fuel or starting pumps are necessary.

The reason for slow development of constant pressure engines are then given and a new form of constant pressure cycle engine is proposed and its operation fully described as is also a special burner giving "flameless combustion," the latter being an essential feature of the engine. This engine compresses into a receiver, heats it with exhaust gas and expands it *at constant pressure* by adding heat (due to combustion of fuel in the burner) as the air enters the working cylinder. Both compression and work take place in the same cylinder. The operation (and resultant card) is practically the same as that of a steam engine, but is accomplished without a boiler, condenser or other accessories used with a steam engine. The proposed engine is said to possess all the advantages of the steam engine without any of the latter's complications or disadvantages.

As applied to motor cars the proposed engine is said to possess the following among other advantages:

(1) It renders readily available for use cheap fuel such as kerosene and fuel oil.
(2) It is thermally efficient at all loads because of constant compression pressure, utilization of exhaust heat, etc.
(3) It has lower maximum pressures, higher M.E.P. and more constant torque than Otto cycle engines. It will therefore be freer from vibration and will be lighter itself than Otto cycle engines. For this and other reasons cited its use will result in lower car weight.
(4) It has a large overload capacity and therefore requires no changed speedgear.
(5) It may operate on a two-stroke cycle with all the advantages and none of the disadvantages of two-stroke Otto cycle engines.
(6) It requires no starter and is expected to be free from carburetion and carbonization difficulties.
(7) Its use will result in simpler car control since no change speed gear on spark advance mechanism will be required.
(8) It will be readily reversible.

Car Performance

By D. L. Gallup

THE author points out the diversity of opinion on what constitutes desirable car performance in the minds of engineers and of the public generally. He believes this is largely due to the great diversity of claims which have been made in advertising literature and decries the sort of tests which have been made the basis of this publicity, pointing out that a majority of them are conducted under such conditions as make it practically impossible for the car owner ever to duplicate or confirm them.

The kind of an expression or test which will inform the buying public most is one which will tell what the car will do in the hands of the average owner, and define the conditions under which a demonstration of this ability can be made, such conditions to be relatively simple and easy of fulfillment.

Only very broad tentative suggestions are made but it is hoped that concrete suggestions will be formulated as a result of the discussion.

High-Speed Engines

By A. P. Brush

THE author outlines in a general way the relation of car performance to modern engine development. He considers particularly weight reduction and torque performance of high-speed engines, giving the undesirable characteristics attending the increased torque range gained by higher speed.

He next discusses the relation of torque to total car weight, to acceleration and to hill-climbing ability and suggests a method of determining the value of a car in terms of its performance ability.

The author holds incorrect those systems in which the amount of lubrication is in proportion to speed only; and in which oil for crankshaft and crankpin bearings must cool as well as lubricate them. He shows a system designed to solve these oiling problems.

Static, running and distortion balance of a rotating mass are defined by the author, who shows how they apply to a large number of types of crankshafts. The paper not only deals with the counterbalancing problem as regards the crankshaft itself, but also with the centrifugal effects of the connecting rod and piston parts. In conclusion a discussion is given of what are correct counterbalancing masses for service conditions.

Some Factors of Safety in Automobile Design

By President Russell Huff

THE author has selected fourteen automobiles on which to make a study of the factors of safety used in their design. He considers specifically the front axles, front-wheel spindles, propeller shafts, clutch shafts, transmission drive shafts and rear-axle drive shafts. The method of calculating the stresses is outlined; compositions of the steels used are given; and complete data are presented showing the factors of safety of the various parts, together with the intermediate figures used in obtaining the factors.

Mechanical Transport Mobilization

By Arthur J. Slade

The paper opens with a number of quotations from publications issued by the Army War College and showing the bearing of motor transport on a proper military policy for the United States. The author then describes two experimental trips recently made by motor-truck owners near New York in an effort to determine proper motor-transport operating conditions. A statistical summary is given for these two experimental trips.

Differential Substitutes

By D. D. Ormsby

MR. ORMSBY considers the conventional type of differential in a somewhat different light than it is usually regarded. According to his view, the conventional differential, rather than being inefficient is, on the other hand, too efficient in that it differentiates for all differences, whereas the automobile engineer only wants it to take care of the unequal velocity of the rear wheels.

Substitutes for the conventional type of differential are considered under four classifications; namely, the free-wheel type, the crank and eccentric types, the spiral gear type, and the solid axle. Examples of each of these classifications are described and the advantages and disadvantages of some of the more practical ones discussed.

In connection with the free-wheel types, the author explains that while these eliminate the inherent defect of the standard differential by differentiating when the wheels have unequal traction, yet with unequal size of tires the free-wheel type will drive more on a large tire because the wheel with smaller tire will have to rotate faster to make up for the distance traveled by the wheel having the larger tire. It is explained further that in making a turn all the power is applied to the inner wheel.

Mr. Ormsby believes that the spiral gear type will be the ultimate solution of the present differential problem.

Considerable space is devoted to a discussion of the elimination of any form of differential whatever. Although such construction has advantages of eliminating the spinning of the wheels and assuring positive travel under all conditions, Mr. Ormsby believes the disadvantages too great to be overcome. There must always occur, when the car is making a turn, a slippage of either the inner or outer wheel, or both, and from experiments conducted with a standard type of touring car and a well-known runabout, the author of the paper has come to the conclusion that the difference in travel of inner and outer wheels in making a turn at a given angle depends on the gage and not upon the radius of the turn. Therefore, no matter how great the radius, the amount of slippage through a given angle is always the same; consequently, no matter how slight the diversion from a straight line, an extra load is always thrown upon the rear wheels, tires and axles where the solid axle construction is used. Another objectionable feature of the solid construction is the extra amount of power consumed in making short turns, on account of the necessity of slipping one or both wheels. Another condition which the solid axle does not take care of is unequal size of tires. In a motor truck one tire is usually worn more than the other. To make up for the greater distance traveled by the larger wheel, the smaller wheel must slide the difference, or the larger must slip part of the time to compensate for the less distance traveled by the smaller one. This would occasion excessive wear on the new tire until both were brought to a uniform size.

Mr. Ormsby mentions some interesting experiments conducted by street railway engineers in connection with using differentials for street cars, to eliminate the corrugation of rails and wheels, as well as to economize in power consumption. It was indicated that with a street car equipped with a differentiating mechanism about one-half the power consumed by a car equipped with solid axles would be saved.

The author believes that the ultimate differential will be one which compensates freely for the difference in speeds of the rear wheels when the car diverges from a straight course, and is so constructed that it will be impossible for either wheel to spin when the other has lost traction.

"The year 1915 stands out more than any other as the one in which considerable effort was made to correct the inherent faults of the conventional type of differential. These efforts have extended into the present year and have been attended with much interest on the part of automobile engineers as well as gear accessory manufacturers. The outcome of present experiments will be of interest to all.

"Before discussing the substitutes that have been designed to rectify the faults of the spur and bevel type differential, let us consider whether the standard types fail through inefficiency or because of too great efficiency. I believe the latter to be the fact. With these conventional gears we find that in making a turn the outer wheel, which travels the greater distance, accelerates and the inner wheel retards, this being the desired action. There is another difference which the standard differential takes care of; that is, a difference in load which is caused by unequal traction of the wheels, by allowing the wheel having the lesser load to revolve faster than the one having the greater load.

"From the above, one can see that the conventional differential rather than being inefficient is on the other hand too efficient in that it differentiates for all differences, whereas the automobile engineer wants it to take care only of the unequal velocities of the rear wheels. It becomes inefficient as a means of transmitting the power to the rear wheels if the wheels have unequal traction. It is to correct this defect of differentiating for unequal traction of the wheels that a great many intended substitutes for the present types of differential have been invented. I will describe a few of them briefly."

The Farm Tractor

By C. M. Eason

THE author shows the need this country has for farm tractors, due to the fact that, so far, less than one-half of the possible farm resources have been developed.

Reviewing the necessity for developing our tillable lands to take care of ourselves in time of war, it is pointed out that farm production is largely a matter of power. Aside from windmills used for pumping water, the available farm power equipment of the United States consists of about 25,000,000 horses and mules, 60,000 gas tractors, 100,000 steam tractors

and 1,000,000 stationary gasoline engines. Large as this total is, however, it only allows 1 hp. for each thirty acres of farm land, which is not enough by perhaps one-half or one-third. Inasmuch as horses cannot meet the demand for increased farm power, the tractor must come right away. So far the supply of tractors has been entirely inadequate to meet the demand.

The writer specifies some of the problems which confront designers of farm tractors. To make the tractor immediately available for farm work, it must be adaptable to practically all of the existing types of horse-drawn implements, besides furnishing belt power for a wide variety of present power-driven farm machinery. In designing tractors it must be remembered that the horse is a very flexible unit, capable of a wide variation in power output. The tractor must compete with this. Designing a tractor to furnish power for the majority of farm conditions requires an intimate knowledge of crops, soils and farm management. These must be analyzed carefully so as to make the machine have as wide a range of usefulness as possible. Mr. Eason dwells on the power required for operations in connection with various crops, including what conditions must be met in the plowing and cultivation. There is a wide variation in this respect as between corn, wheat, oats and other crops. The power required for pulling plows varies from 250 to 1500 lb. per bottom, depending upon the condition and kind of soil, depth and type of plow. One objection to the tractor is that it must be made to follow the furrows by careful attention from the driver, whereas a horse follows the furrow instinctively.

The author reviews what the tractor must show in the way of economical operation, pointing out that for permanent success it must show higher returns on the investment than horses.

Valuable information is given in regard to the mechanical efficiency, engine efficiency, friction losses, rolling resistance and general design requirements. Other factors peculiar to farm tractor work, which must be taken into account, are treated. The tendency in tractor design is toward better material, greater refinement and higher efficiency.

Bronze Alloys for Automobile Construction

By W. M. Corse and G. F. Comstock

THE authors point out the need for more concrete data concerning the physical properties of bronze alloys and present an extensive chart covering the results of actual tests on a large range of cast bronze alloys. The influence of the method of making a test-specimen is discussed and it is hinted that new evidence concerning the proper interpreting of the true proportional limit is available.

A very extensive set of photo-micrographs illustrates the variety of structures existing in the ordinary and in some unusual bronze alloys.

Large Single Versus Dual Solid Tires for Rear Truck Wheels

By W. H. Allen

THIS paper is mainly an argument in favor of the use of large, single rear wheel truck tires instead of smaller dual tires. Although the practice of using large singles is comparatively new, the author gives the results of experience and research to show the advantages of the newer method of rear tire equipment.

In developing his arguments in favor of single tires, the author goes into the history of dual tire application to show why it was necessary to use two tires in the earlier days of truck operation. As the necessity for increased carrying-capacity grew, tire manufacturers found the then existing single tire equipment inadequate, and they set about to develop suitable equipment to meet the new condition, the result being dual practice. According to Mr. Allen, dual tires were supposed to have a carrying-capacity two and a half to three times that of a single tire of the size of which the combination was composed. The method of attaching the earlier dual tires is shown to have been poor, inasmuch as the cross bars tended to draw the rubber together in such a way that it was impossible to secure the same degree of friction over the entire base, owing to the outward spring which took place in the center of the cross bar, thus relieving compression under these bars. This reduced the stability of attachment, which resulted in circumferential creeping of the whole tire to a much greater extent as the width of the dual equipment increased. Inability to correct this weakness resulted in conclusion to the effect that tires of such method of attachment were not suitable when widths in excess of 4 or 5 in. were employed. The metal base type of tire was developed to overcome the difficulty.

Mr. Allen holds that dual tires are overrated, and believes that the practice of saying that dual equipment is capable of carrying loads double that of the single of which it is composed, is open for discussion.

Some reasons for advocating large singles in place of small dual equipment are:

1. The contact area of single tires exceeds that of the duals which they are proposed to replace. 2. The load per square inch distributed over the contact area is in every case reduced correspondingly with the increase in contact area. 3. Small dual equipment does not give satisfactory performance for the reason that neither single tire is sturdy enough to resist momentary imposition of the total wheel load, such as occurs, for example, when traveling over rough road surfaces, excessively crowned or furrowed roads. It is pointed out that in such cases one of the small tires carries during a large part of the time the entire wheel load, which is shifted back and forth from one small tire to the other; with large, single units the load is concentrated on a tire sufficiently sturdy to absorb reasonable load inequalities. 4. Saving in tire cost, ranging from 8 to 15 per cent. 5. Saving in wheel cost, because of narrower felloe and wheel rim. 6. Saving in cost of handling and applying one tire in place of two. 7. Saving in wheel, tire and rim weight. 8. Fitting of non-skid chains easier. 9. Better trackage with front wheels. 10. Greater height of rubber tread, providing better cushioning properties and increasing tire lift. 11. Less strain on axle and wheel bearings.

The large single tire has, however, its limitations and, pending the results of further investigation, it seems advisable to consider 7-in. tires as the limit of practical single equipment.

The Pneumatic Tire and Rim Situation

By J. E. Hale

MR. HALE follows up the development of the pneumatic tire since its invention by Dunlop in 1888, and shows why there are now several different types of tire construction in use. The main thought expressed is that the straight-side tire is the logical solution of the variety of requirements, in this country, South America and Europe.

Why should the car manufacturers continue to complicate their production processes by making some of their cars with millimeter clincher equipment and others with straight-side, when by proper co-operation between the tire and car makers, the straight-side tire can be introduced quietly into the foreign market, fully standardized? Mr. Hale discusses in detail the merits of the three types of tires; namely, the clincher, straight-side and quick detachable, confining his discussion to energy consumption, traction, total mileage, cost-per-tire-mile, cushioning effect, reliability, ease of applying and service. The results brought out show principally the advantages of the straight-side tire.

Statistics are offered to show the trend of the rim situa-

tion, and it is pointed out that it is just a question of time until the quick detachable clincher will cease to survive. It had a legitimate place during the development stage, but with the developed straight-side tires giving entire satisfaction, Mr. Hale holds that there is no excuse for continuing the quick detachable clincher type.

The American standard inch clincher rim contours, the British standard millimeter clincher rim contours, and the American wide standard inch straight-side rim contours will undoubtedly survive all others. However, outside of the rim contours, the rim situation is still in the process of evolution. In the struggle to minimize weight, expense, and tire troubles, the existing demountables may lose ground, particularly as the light-weight one-piece clincher and the two-piece straight-side rims, on either permanent or detachable wheels, apparently offer the next step in progress of this department of the automobile industry.

On the Dynamics of Vehicle Suspensions

By Dr. Benjamin Liebowitz

THE author believes the riding qualities of present motor vehicles are unsatisfactory and that this is due largely to a lack of appreciation on the part of automobile engineers of the fundamental dynamics of the problem. He undertakes to strip the problem down to the consideration of a simple system consisting of a wheel with its sprung weight carried on a simple type of spring and then to analyze the action which takes place when simple irregularities are encountered by the wheel.

Analysis of this problem results in several expressions, the interpreting of which reveals the influence which the varying of specific factors has upon the action of the spring and its suspended load. These expressions take into account the effect of the ratio between sprung and unsprung weight, of speed, of size and kind of irregularity encountered by the wheel, tire inflation, flexibility of the spring, and wheel diameter. Other factors which are considered as a result of interpreting the very interesting curves are the effect of friction in the suspension, and of synchronism. Statements of the betterment which can be looked for in riding and steering qualities as a result of varying different factors are made. The effect of shock absorbers is discussed.

Kerosene Versus Gasoline in Standard Automobile Engines

By Charles E. Lucke

THE author outlines the factors leading up to the present high cost of automobile fuel, states that the introduction of new distillation processes will not solve the problem, but that the development of kerosene-utilizing appliances will produce results satisfactory to everybody.

The paper proceeds to show why kerosene cannot be used on the present gasoline cars. The adaptation of the gasoline automobile engine to the use of heavier fuels than will vaporize without the use of heat is entirely a problem of heating and heaters.

The author reviews at length the principles embodied and the construction of the heated vaporizers or vaporizing heaters now used in stationary and traction kerosene engines and in alcohol engines, giving illustrations of a number of such devices.

After thus developing what in his opinion are desirable and good principles, the author describes a form of vaporizer embodying such principles, which he states has had successful trials (both block and road) in automobile service. A semi-automatic starting burner to accompany the vaporizer is also described, both as regards its construction and operation. In conclusion the hope is expressed that the principles outlined will result in the production and use of kerosene automobiles on a scale sufficiently large to affect the price of fuel within the next year.

Coarse Crystallization in Cold-Pressed and Cold-Drawn Steel Parts

By Ralph H. Sherry

FOR reasons of economy in production and in construction cold-worked low-carbon steel in such forms as cold-rolled or cold-drawn bar stock and cold pressings has assumed an important position in motor car construction. Expensive and heavy castings have been replaced by cheaper and lighter pressings and the use of cold-drawn or cold-rolled bar stock has permitted the use of greater speed in machining with a resulting increase in production. There has been, however, one factor which has made the use of such material seem of doubtful value from the standpoint of reliability. From time to time certain parts made from cold-worked low-carbon steel have been found to be exceedingly brittle, a condition usually accompanied by a coarsely crystalline fracture which in some cases resembled fractures found in steel known to be "burnt." Mysterious epidemics of brittleness appeared intermittently in material supposed to be in the best possible condition. The annealing usual in such cases not only did not cure the trouble but often seemed to aggravate it. Parts were often placed in service with a feeling of doubt as to their reliability. The cause of the trouble being unknown, breakage of such parts was ascribed to "crystallization in service."

The causes of this condition have gradually become known and methods of control have been clearly defined. In this article the author gives the results of an investigation of this phenomenon which was carried out with commercial materials such as cold-drawn wire, hot and cold-rolled sheet, strip steel, cold-drawn tube, and cold-pressings. The results of other investigations are briefly outlined.

Coarse crystallization, or grain growth, it is stated, is due to the action of a limited amount of strain, exceeding the elastic limit, followed by annealing within certain temperature ranges. The experimental work which led to this conclusion is stated in detail in the article. The effect of forging, cold-drawing, cold-rolling and cold-pressing was determined with commercial materials. Some study was made of the effect of carbon on grain growth and of the effect of coarse crystallization on the physical properties. No grain growth was noted in steels that were uniformly above 0.15 per cent in carbon content. The effect of coarse crystallization on the physical properties was marked. Not only was the resistance to shock seriously lowered, but there was also a marked drop in the elastic limit, maximum strength and elongation.

In the discussion of commercial materials special reference is made to those used in motor car construction. Methods are given by which coarsely crystalline material may be detected. Methods of control which are necessary for the elimination of coarse crystallization are given in detail for each commercial material investigated, together with a general summary of the essential factors. When it is considered that the ranges of temperature within which coarse crystallization is produced are those within which annealing usually takes place, the necessity for exact knowledge of the details becomes apparent. The materials which receive individual consideration here are sheet, strip steel, cold-drawn tube, cold-pressings and cold-drawn rivet stock. The occurrence of coarse crystallization in cold pressings, of particular interest to the automobile engineer, has received special attention.

The author's conclusions outline briefly the general conditions under which grain growth occurs as determined in his investigation. Accompanying the article are tables giv-

ing in detail the results of cold-rolling and cold-drawing, together with other experimental data. A considerable number of photo-micrographs are given which illustrate a number of the factors determined in the investigation.

Automobile Experiences in the Great War

By W. F. Bradley

THE author outlines the constructions that have shown up well under war conditions of operation, mentioning especially that four-cylinder engines carried under a hood were the most satisfactory. The internal combustion engine had found favor as compared with the gasoline-electric and steam-driven vehicles. The defects revealed by war service are given in considerable detail, the author finding that all of the trucks used had developed some weak point. Radiators and springs were given as a general source of trouble. The author believes more attention should be paid to the draining off of water from radiator, pump and jackets. The lubricating system for the engines should be of the pressure or circulating type so designed that the dirt will deposit away from the pumps. He outlines a number of operating troubles developed under the existing conditions of operation and gives examples of the way these have been remedied.

Considerable attention is paid to the methods of operating trucks away from made roads. The methods of fitting chains to the wheels and the use of carterpillar attachments are described. All-metal wheels are being used in place of the wood wheels. Considerable tire trouble has developed; one reason being the tendency for the cambered roads to force one of the dual tires to carry the greater portion of the load. Dimensions are given for bodies and a number of suggestions made as to their proper construction.

Although practically all the general transportation is done by rear-driven trucks the four-wheel-driven vehicle is used to a limited extent mainly for operation off the main roads or on no roads at all. A description is given of tractors developed for this service. These are used mainly to draw batteries and heavy artillery. The importance of the armored car has been exaggerated mainly because of the adoption of underground warfare. The author describes briefly the most suitable type of such a machine. One effect of the war has been to bring about the extensive use of trailers, the author stating that they are now being used behind all kinds of automobiles, both for the transportation of men working in the rear of the lines and for general haulage work around the depots.

In conclusion the paper considers the arguments found in the war zone in favor of standardization. The author holds that such a tendency should be opposed as regards the general features of automobile design. Certain features that can be adopted without handicapping the design should, however, he insisted upon. He gives specifically the size and style of bodies, sizes of wheels and tires, magneto bases and couplings, carbureter flanges, towing hooks, turning radius, clearances, driving chains, and threads for all bolts and nuts as subjects for standardization. He also mentions the necessity for uniform nomenclature inasmuch as a great deal of confusion has been created by the difference in the names of American trucks, not to mention the trouble caused by the variation in English and French terms.

Recent Aeroplane Engine Developments

By Neil MacCoull

THE author gives a brief review of developments during the past year in the construction of aeroplanes, particularly as affected by the European war. He takes as an example the Renault twelve-cylinder engine, citing the respects in which the present differs from previous models. Such factors as the changes in cooling systems, method of drive, valve construction and starting devices are considered.

The requirements of aeroplane engines, such as constant service, high speeds (of aeroplanes) and stream-line form of engines and radiators, are outlined. Propellor requirements are dealt with at length, curves being given by which the efficiency and diameter of the propeller can be obtained. In conclusion a number of different engine installations are illustrated and compared.

Refinement and Generalities in Truck Design

By H. D. Church

THE author describes a number of detailed developments that took place during the working out of a line of worm-driven trucks.

The details of front axle and steering parts are dealt with at length, the reasons for the final constructions being clearly explained and the constructions themselves well illustrated.

Details concerning difficulty with the Hotchkiss type of drive on heavy trucks, troubles with drive shafts and lubrication of the worm wheel are all covered thoroughly; spring shackle construction and lubrication, radiator and hood mounting come in for detailed attention, and the question of governors is interestingly covered.

Brief reference is made to the influence of unsprung weight, the differences between truck and pleasure car practice in this respect being pointed out.

Moreland Sprinklers Show Economy Over Horses

OVER a year ago the officials of Los Angeles, Cal., began investigations to determine the cheapest and most effective method of cleaning the streets. A motorized equipment was finally decided upon, and the city engineering department prepared plans for modern sprinklers and flushers, embodying numerous improvements over other systems and in keeping with the other motor equipment already installed in other departments. Later the contract for the sprinklers and flushers was let to the Moreland Motor Truck Co., Los Angeles.

The official tests show a large saving in the cost of operation over the cost of operating horse-drawn vehicles. One outfit of horse-drawn apparatus will sprinkle 5 miles of street in an 8-hr. day at a cost of $4.50; while one truck will sprinkle 38 miles in 8 hr. at a total cost of $14.71. These figures show that each truck will save the city approximately $20 every 8 hr. Furthermore, the trucks are so constructed as to eliminate all overlapping of the streams, with a consequent saving of 25 per cent of the water used in the old sprinklers.

In the night hours the trucks are used for flushing and here they show to even greater advantage when compared with horse-drawn equipment. One driver, team and harness cost the city $5 a night. The flushers are owned by the city, and the interest on the investment, depreciation and upkeep is figured at $1 a night. Taking into consideration the greater amount of territory covered by the motor flushers and the lower cost of operation, each truck will save the city $21 a night. When to this amount is added the $20 saved by each truck during the sprinkling hours, it appears that each truck so used will save the city $40 every day in the year.

British Standardize Automobile Steels

Following Example of American Industry—Ten Steels Agreed Upon by Automobile Engineers, Steel Makers and National Engineering Standards Committee

AS was mentioned last week in THE AUTOMOBILE, the American lead in matters of standardization is being followed by Great Britain. In *The Automotor Journal* (British) for May 12, there is a good review of these standard steels from the engineer's viewpoint. The author is A. E. Berriman, chief engineer of the Daimler Motor Co., a man holding a high position in the British industry. His report follows:

The publication of the British Engineering Standards Committee's specifications for automobile steels inaugurates a new phase in the progress of this industry, and renders important assistance to its allied branch of aircraft manufacture.

Ten classes of steel have been labeled by these official specifications, and they cover the whole range of the more important kinds in common use.

There are four case-hardening steels and six steels that may be called, for distinction, stamping steels.

The E. S. C. specifications are wide, that is to say, they define classes rather than "brands."

This is as it should be. There is nothing to prevent users with particularly definite requirements from obtaining special casts of steel to guaranteed fine limits of chemical composition.

Steels of Average Requirements

The specifications themselves were drawn up by a committee of the Institution of Automobile Engineers, comprising steel makers, stampers and automobile manufacturers. The steels specified, therefore, may be taken as representative of average requirements.

The formation of the committee in question was the direct outcome of a paper read by L. H. Pomeroy, technical director of Vauxhall Motors, Ltd., before the I. A. E. during the early part of the war.

It must be remembered that all the steel used in motor cars is "special" from the standpoint of ordinary engineering construction. These specifications are, therefore, a first attempt to define the more commonplace materials of a particular group.

So far from handicapping development, this standardization of what is merely ordinary should promote intelligent interest in what is really new. Undoubtedly, much confusion of mind hitherto has prevailed among steel users about matters well known by steel makers to be insignificant.

To Test Physical Properties

The standardization of these steels has prepared the way for an important line of research that has been undertaken by the joint research committee of the Society of Motor Manufacturers and the Institution of Automobile Engineers. The funds for this research have been contributed partly by the Government, partly by the S. M. M. T., and partly by individual firms in the automobile industry. The object of the research is to test the physical properties of the standard steels over the range of chemical composition tolerated by the specifications and over the range of heat treatments appropriate to the class of material.

When this information is published, the full value of the specifications themselves will be realized, and the automobile industry will have acquired a collection of data that has long been wanting as the basis of scientific design.

Under the ordinary conditions of commercial production, it is essential that the engineering department's specification should give sufficient latitude for the proper exercise of the functions of the purchasing department. This co-ordination is much facilitated by the E. S. C. standards, for it is now possible for the engineering department to place a thoroughly definite specification on the drawing without limiting the source of supply.

E.S.C. STANDARD STEELS (*Tons are long tons = 2240 lb.*)

	Case Hardening Steels				Stamping Steels					
	"10" Carbon	"15" Carbon	2 Per Cent Nickel	5 Per Cent Nickel	"20" Carbon	"35" Carbon	3 Per Cent Nickel	1½ Per Cent Nickel Chrome	3 Per Cent Nickel Chrome	NC Air Hard
Carbon	.08/.14	.12/.20	.10/.15	†.15	.15/.25	.30/.40	.25/.35	.25/.35	.20/.30	.28/.36
Silicon	†.20	†.20	†.30	†.20	†.25	†.30	†.30	†.30	†.30	†.30
Manganese	†.60	.65/.10	.25/.50	†.40	.40/.85	.50/.85	.35/.75	.35/.60	.35/.60	.35/.60
Sulphur	†.04	†.07	†.05	†.07	†.06	†.06	†.04	†.04	†.04	†.04
Phosphorus	†.04	†.07	†.05	†.05	†.06	†.06	†.04	†.04	†.04	†.04
Nickel	....	....	2.0/2.50	4.75/5.75	....	....	2.75/3.50	1.25/1.75	2.75/3.50	3.50/4.50
Chromium	....	....	....	....	....	....	....	0.75/1.25	.45/.75	1.25/1.75

Check Tests

Solely to provide a uniform basis for checking consignments irrespective of the state in which the steel is to be used. The test bar must he heat-treated when 1¼-in. in diameter.
Treatment:—N = Normalized; OH = Oil hardened; AH = Air hardened; T = Tempered deg. C.

	N	N	N	N	N	N	N	OH/850	OH/820	AH
Treatment deg. C.	900/920	890/920	850/900	820/860	890/920	850/880	840/880	T600	T600	820
Max. stress, tons/in²	23/28	25/33	25/35	25/40	26/34	30/40	35/45	•45	•45	•100
Elastic ratio, per cent	•50%	•50%	•55%	•60%	•5$%	•50%	•55%	•70%	•70%	•75%
Elongation	•30%	•28%	•30%	•30%	•28%	•25%	•24%	•15%	•15%	•5%
Reduction	•50%	•50%	•55%	•55%	•50%	•45%	•50%	•50%	•50%	•13%
Brinell (approx.)	92/112	103/143	103/153	103/179	105/149	121/179	140/202	179	179	418

* = Not less than. † = Not more than.

Colors in Which Steels Should be Painted Before Delivery

Case Hardening Steels				Stamping Steels					
"10" Carbon	"15" Carbon	2% Nickel	5% Nickel	"20" Carbon	"35" Carbon	3% Nickel	1½% Nickel Chrome	3% Nickel Chrome	NC Air Hard
Yellow	Yellow and Dark Brown	Yellow and Red	Yellow and Violet	Light Brown	Dark Brown	Red	Light Blue	Violet	Green

Such a specification might read, for example, 3 per cent nickel chrome steel to fulfill R. A. F. test No. 32a. This insures the supply of an appropriate class of material for the work, and its use in a suitable heat-treated condition; at the same time, it enables the entire steel industry to compete for the business on even terms.

Building Up Reputations

It is, however, necessary to remember that much of what constitutes "quality" in steel appertains to detail of manufacture that cannot be recorded in the chemical composition, and is not necessarily apparent in the physical tests. Reputation, both for good material and for good service, is, therefore, likely to be much more securely founded in the full light of the standard specifications than ever it was before under the vague glamour of a "brand."

In the long run, it will be worth more to the steel maker to supply the best steel of a universally used class, than a very good steel of an isolated kind.

The specification of high quality was not really faced by the committee responsible for drawing up the E. S. C. standard steels, and there is no doubt that useful work remains to be done in this direction by any representative group of steel makers willing to concentrate upon the subject. The absence of a quality clause in the E. S. C. specifications is no detriment to their fundamental purpose, for it must be remembered that quality is a question of degree and therefore of price. It is undesirable in engineering to employ steel that is unnecessarily costly for its purpose, and it would be a mistake for the standard steels arbitrarily to define only the highest quality, and, therefore, the most expensive class of material. It is, however, important that engineers should be able effectively to specify the highest quality when they require it. On this aspect of the subject authoritative information is at present lacking. To say, for example, that a steel must be crucible cast, is perhaps to take a very arbitrary action in respect to the capabilities of the electric furnace, which may be able to produce the highest quality steel more economically. Similarly, there are points in connection with the casting of the ingot and its subsequent preparation into the billets and bars of commerce on which the steel making industry might well prepare some authoritative information that would serve as a most useful supplement to the existing E. S. C. standard specifications.

The accompanying table summarizes the E. S. C. standard steels, and gives additional information relating to the testing of steel.

Check Tests for Stock

Check tests for steel that is bought for stock purposes are included in the E. S. C. specifications. Most of them are specified for annealed test bars in order to facilitate uniformity of the conditions under which the steel is checked.

Steel that is bought for a particular purpose as defined by a special test must necessarily be the subject of special arrangements as between the purchaser and the supplier.

In principle, the responsibility for producing the results should coincide with the source of the specification; and the appropriate source for the specification is the firm undertaking the heat treatment.

Maker Is Responsible

In short, if the steel maker supplies heat-treated steel, he should be wholly responsible. If the stamper heat treats the steel, he should be responsible for the specification and for the results, the steel maker being merely responsible for the standard check test. If the engineer manufacturer heat treats his own steel, he should specify it and be responsible for getting the results, and also for getting good stampings that do not spoil the steel.

In any event, if the purchaser discloses the results he requires, a responsibility naturally rests with the steel maker to demur if he considers the steel specified to be unsuitable for the purpose.

When the research on the physical properties of these steels is published, the appropriateness of any particular physical test will rest on a firmer foundation than it does at present.

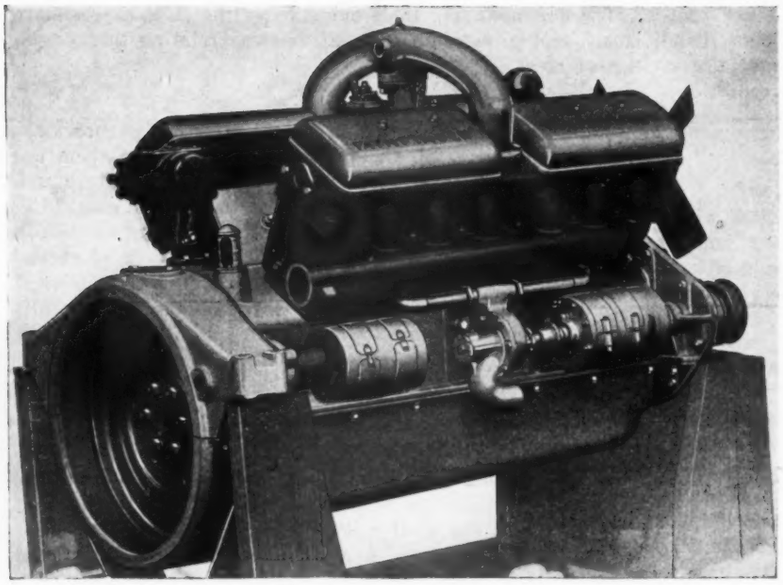
In the meantime, it is only possible in a general way to use a hypothetical series of tests based on the characteristic variations of the physical qualities of steels.

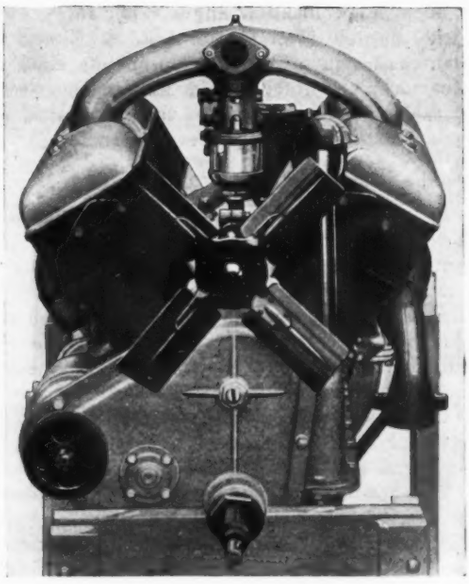
A Scheme of Coloring

The E. S. C. standards specify a scheme of coloring to facilitate the visual identity of steel. It is to be hoped that uniformity in this direction will come into vogue. Most firms have some system of coloring, and as none can be perfect, all might as well conform to the E. S. C. standards, so that the steel could be painted at the source.

Trucks Expedite Delivery of S. K. F. Bearings

THE accompanying illustration shows how the S.K.F. Ball Bearing Co. rushed a shipment of 40 tons of bearings from the parent factory in Sweden to the new plant at Hartford, Conn., before which the train of Mack trucks and their trailers are lined up. The bearings were needed to fill rush orders from manufacturers of automobiles, machine tools, textile machinery, etc., and, due to war conditions, hold-ups in the customs and other delays, the company chartered the trucks and trailers, thus saving many precious hours in the delivery of the three hundred cases of bearings at the Hartford factory, whence they were shipped to customers. The new plant will commence making S.K.F. bearings next month, the machinery being practically all installed.





Twelve-cylinder Weidely engine used in the 1917 Pathfinder chassis. Side-by-side connecting-rod bearings are used

1917 Pathfinders All Twelves

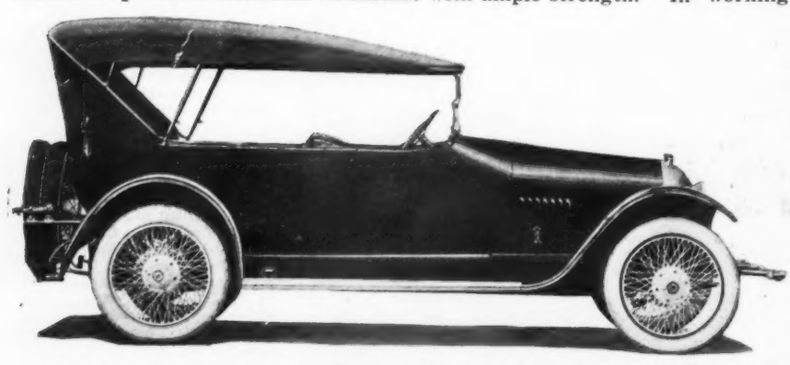
Six-Cylinder Model Discontinued — Weidely 2⅞ by 5 In. Motor with Overhead Valves Employed

PATHFINDER cars for the 1917 season will have twelve-cylinder engines exclusively. The entire chassis has been redesigned to take the new power plant and this model, which is put out in two body forms, touring and cloverleaf, now makes up the entire line of the company.

Probably the most distinctive feature of the car is the power plant which is the Weidely 2⅞ by 5 in. twelve-cylinder unit. This is also manufactured in Indianapolis, not a very great distance from the Pathfinder factory.

The cylinders are cast in blocks of three with the head castings, containing the intake manifolds, water outlets and valve seats, in blocks of six. With this arrangement the stiffness of the block casting is secured and at the same time the cylinder castings themselves are simpler. The right set of cylinders is pushed 1¼ in. forward of the left to provide for side-by-side connecting-rod bearings on the crankshaft.

Cast-iron pistons are used, and they are fitted with patent high-compression rings. There is an oil ring at the bottom and a V-groove cut all around the piston, which is drilled for oil passage. The connecting-rods are elliptical in section. They are drop forged and have the weight reduced to the lowest practical minimum consistent with ample strength.



Pathfinder seven-passenger La Salle touring car which sells for $2,750. Like the Cloverleaf, it is mounted on a 130-in. chassis

A 2⅛-in. crankshaft is used, carried on three main bearings and provided with the curved-cheek counterbalancing system, the oil leads for the pressure system being carried in tubes across the curved cheeks.

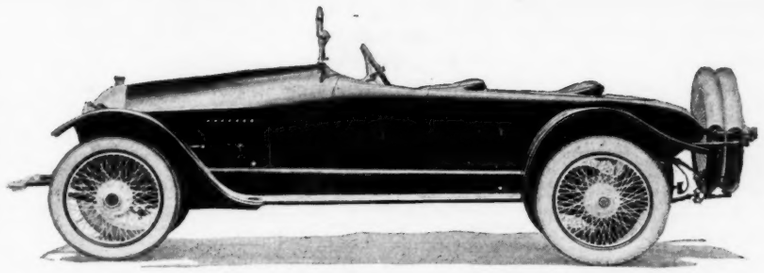
A feature of the valve action is in the exceptionally wide faced helical gears. These are so arranged that there is a constant drag on the gears, even at idling speeds, thus preventing them from rattling when not under load. The entire valve drive is taken off a single camshaft which is provided with twenty-four cams. These are integral with the shaft, which is a hardened and ground drop forging. The camshaft is placed directly above the crankshaft. The cams act directly upon mushroom followers, the tappets passing through long guides, the pushrods extending upward behind the cover plates to the rocker arms.

The valve diameter is 1½ in. in the clear. The springs are large in diameter and the rocker arms bear directly on caps on the end of the valve stems. The entire valve mechanism is inclosed by aluminum cover plates which extend over the tops of the cylinders, covering the rocker arm mechanism and also inclosing the push rods at the sides. In working out the oiling system the lower half of the crankcase forms the oil pan in the usual way. This pan is covered with a strainer so that all droppings from the motor are screened before they enter the space below which contains, at its lowest point, the oil pump.

There are four leads from the oil pump. Three of these go to the main bearings, whence the oil enters the drilled crankshaft and is led to the connecting-rod bearings by means of the tubes across the curved cheeks of the crankshaft, as described. The fourth lead carries the oil to the camshaft, and takes care of the bearings for this shaft as well as the tappets. The overflow from the fourth lead also supplies the timing gears with a copious supply of lubricant. Special provision is made for maintain-

ing a supply of oil at the rocker arms so that only infrequent oiling is necessary.

A neat arrangement of the water circulation has been provided, in spite of the natural difficulties presented by the separate castings for valve head and cylinders, and also by the overhead valve action. The water pump is mounted on the generator shaft which is driven off the fourth gear of the timing set. The pump is about the center of the motor on the right side. The water intake is at the lower end of the pump and it is led out through a divided manifold at the top. The water enters the lower part of the cylinder blocks on the right side and is fed directly to the waterjacket of right block.



Pathfinder Cloverleaf roadster for 1917 which lists at $2,900. Wire wheels and 35 by 5 tires are standard equipment

The water for the left block passes through a lead tunnelled through the crankcase and formed by a core in this casting. The aluminum integral tube is lined by a steel tube which is driven through, forming a passage for the water. A Fedders radiator is used, cased with German silver. It is supported on an individual cross member which is detachable and so arranged that the supporting members do not put any strain on the radiator itself. It is maintained in an upright position by stay rods. The edges of the radiator are rounded off in a distinctive style and conform to the shape of the Pathfinder hood. The water capacity is close to 12 gal., the big capacity being obtained by the V-shape and the 4-in. cores.

Manifolds Are Combined

In arranging the manifold work on the car the water outlet from the cylinders and the intake pipe have been merged together. This produces the two-fold effect of the waterjacketed intake and a unit casting which carries both the water and the intake gases. The intake is semi-elliptic in shape, with the carbureter beneath and the flange for the radiator connection in front. This is a ground surface to allow for a tight gasket.

Balanced Gas Flow

Carburetion is provided by a specially arranged Stromberg instrument of the H-type, slung in the center between the two cylinder blocks. The effect is perfectly symmetrical and should give exact balance of the gas flow. The exhaust is led to the outside of the head casting and the manifold is swept low to keep the heat away from the occupants of the car. Separate exhaust headers are provided for each cylinder block, leading to separate mufflers so that the back pressure due to exhaust in one cylinder cannot affect the exhaust of another.

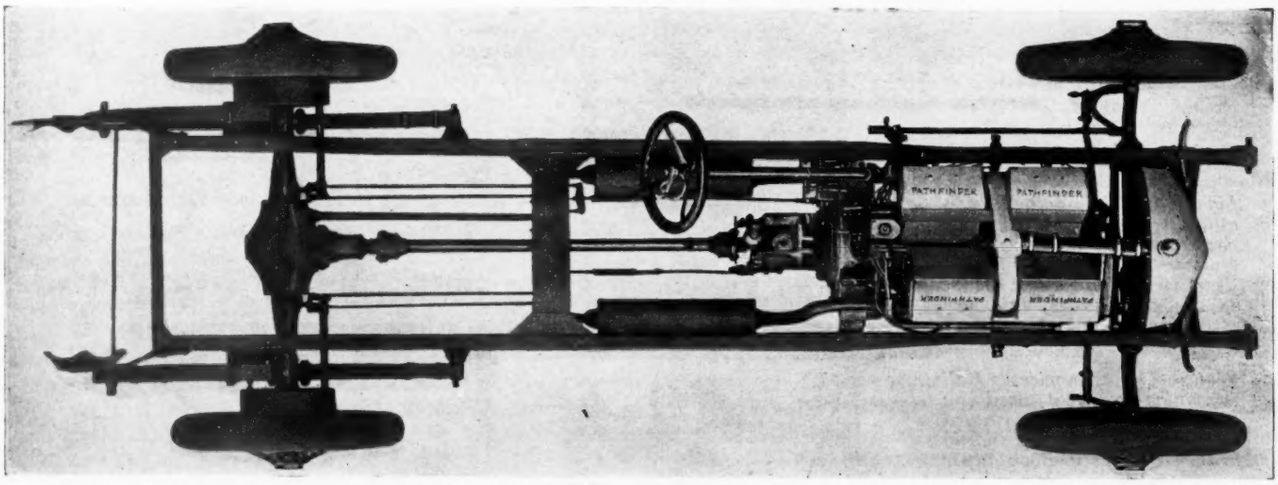
Gasoline feed is provided by the Stewart vacuum system. The tank is suspended on the rear of the car and has a capacity of 21 gal. The manufacturers claim that mileages with this car 14 to the gallon are not exceptional. A detail of interest is that in case of flooding of the carbureter the space between the cylinder blocks is arranged as a drain and carries away the gasoline instead of allowing it to accumulate there as a possible cause of fire.

Electrically the car is entirely Delco, the three-unit system for starting, lighting and ignition being used. Initial current is supplied by a 160-amp.-hr. storage battery floating on the line. This is supported on the right frame side member. The timer-distributer is mounted on the top of the rear end of the crankcase and is driven by a vertical shaft which carries at its lower extremity the oil pump. The drive is taken from the camshaft. There is a centrifugal governor in the base of the timer housing which regulates the spark under normal running conditions. In addition there is a hand advance for setting the spark manually if so desired.

Delco Starting System

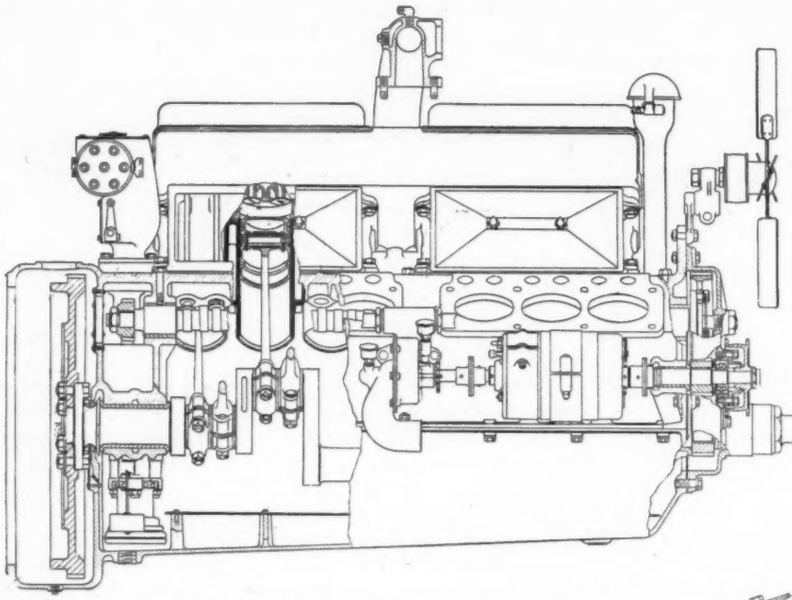
Starting is by the independent series-wound Delco unit so wired that the motor is cranked by pressing a button. A feature of the starting motor is the detachable commutator housing. The capacity of the battery on this car is said by the manufacturers to be such that it is capable under normal conditions of furnishing sufficient current to crank the engine steadily for 25 min. There are only two wires from the starting motor to the battery, the switch being in the line.

Like the remainder of the electrical equipment, the lighting system operates at 6 volts. A feature of this unit, which is also of Delco manufacture, is the ease of reaching the brush assembly by removing the detachable cover plates. This permits of ready inspection of the brushes and also allows the ordinary owner to keep this part of the generator clean with-

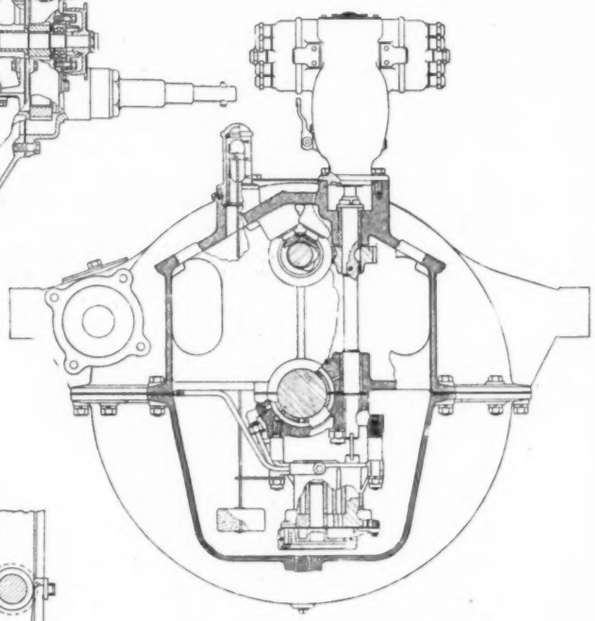


Pathfinder 1917 chassis showing mounting of the twelve-cylinder Weidely unit power plant. This chassis has 130-in. wheelbase and either touring car or roadster body is fitted

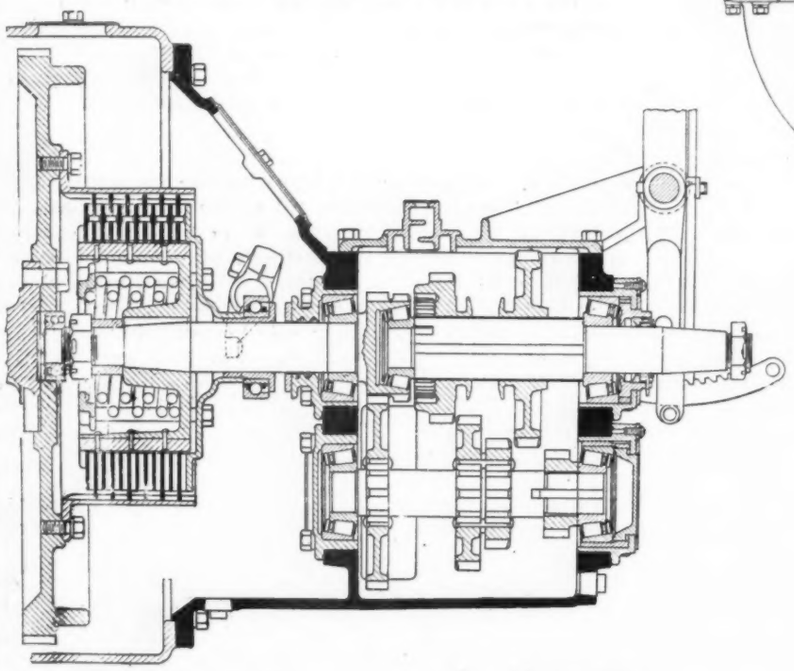
Details of the Pathfinder Twelve Chassis



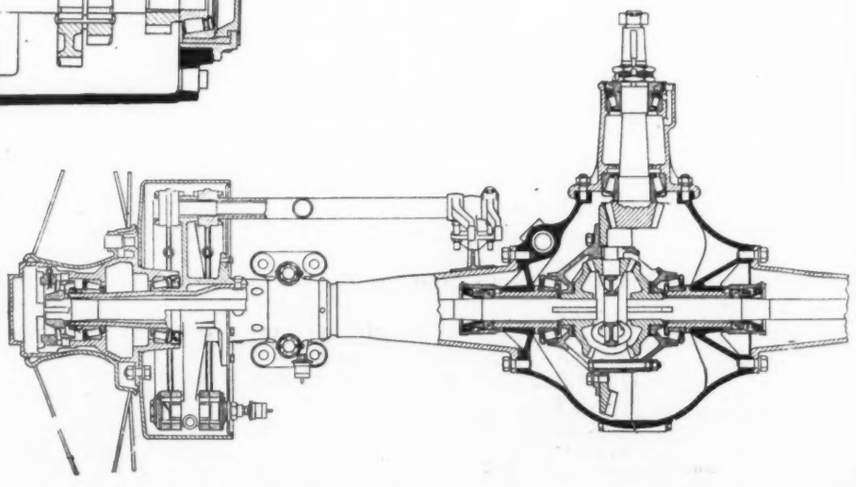
This drawing of the Weidely-Pathfinder twelve-cylinder engine gives a good idea of the internal simplicity and the accessible layout of the engine accessories. There is a cored hole passing right across the crankcase, behind the pump which takes water to the further cylinder block; it is lined with a steel tube to prevent leakage



End section of Weidely engine showing the oil pump and the float for indicating oil level. The distributer and the tappet gear are also shown above. Notice the way in which the oil pump driving shaft is connected to the distributer shaft



Above—Multiple-disk clutch and three-speed transmission used on Pathfinder chassis. Notice the breather on the gearbox cover to allow escape of air and so prevent the expulsion of lubricant through the bearings



Right—The American Ball Bearing Co. axle used by Pathfinder. This is a rugged type with double expanding brakes and uses Bock taper roller bearings

out having to wait until serious trouble makes a trip to the service station necessary.

Complete Lighting Equipment

The headlights have two sets of bulbs, for country and city driving. There is a rear tonneau light controlled by a convenient switch and also a cigar lighter which is countersunk in the back of the front seats and which is accessible to those in both the front and rear. The headlights are mounted on extra rigid brackets and all the wiring is inclosed in flexible conduits.

Asbestos and steel are used in the dry plate clutch. There are six asbestos faced disks which form the driving member. These act against hardened and ground steel plates which form the driven member. There is one stiff coil spring holding the clutch in engagement. No lubrication is used on the clutch.

Unit Power Plant

A unit power plant is formed by the gearbox, clutch and motor. The bell housing is an S. A. E. type and the plant is supported at three points with a trunnion carrier in front. Timken bearings are used throughout the entire transmission. The gears are held in mesh at any speed by a gear interlock which locks the sector not in use.

The drive is taken to the rear axle through a universal joint and propeller shaft. The rear axle is a floating American type, with 1¼-in. axle shafts of chrome-nickel steel. The central housing is a malleable casting and the external ends of the housing are made up of 3½ per cent nickel steel tubing. The driving gears are spiral bevel and made from nickel steel carried on Bock taper roller bearings.

Rear Springs Underslung

Vanadium steel springs are employed with three-quarter elliptics in the rear. The front springs are 39 in. long and 2¼ in. wide. The rear are the same width and 54 in. long. Bronze bushings are used. The drive is taken through the front ends of the springs, which are shackled only at the rear. The springs are swung under the rear axle, giving the car a low appearance.

Convenient Seating Arrangements

Both body models, the La Salle seven-passenger and the cloverleaf roadster, are mounted on the same 130-in. wheelbase chassis. The front seats on the touring car are divided and the auxiliary seats fold into the backs of the front seats. Touring cars are furnished as standard in blue black, wine and dark green, with white wire wheels. Cloverleaf roadsters are furnished in red, yellow, battleship gray and blue black with red wheels. The wheels are Houk wire and the prices are $2,750 for the touring car and $2,900 for the cloverleaf. The tire size is 35 by 5 and equipment is complete in every particular.

High Spots in S. A. E. History

(*Continued from page* 1011)

sions thereon, except in the matter of their official publication under the Society's imprint as its Transactions. The policy of the Society shall be to give the professional and scientific papers read before it the widest circulation possible, with a view of making the work of the Society known, encouraging engineering progress and extending the professional reputation of its members."

Wide Scope of the Work

It is clear that the Society has performed and is performing an important public duty. It is deserving of very widespread support. Its work is of interest not merely to the technician but to the layman who demands efficiency, safety and comfort, but who has little idea how largely these desired qualities are the fruit of vast research and labor.

Theoretical Side Not Neglected

It is entirely logical that the S. A. E. should have become a real power to which can be referred numberless engineering questions which can be settled definitely only by the official action of some organized non-partisan body. Meanwhile the theoretical work has gone on, and more and better papers have been presented and discussed at its successive semi-annual national meetings.

Its Distinguished Membership

In the words of a veteran critic, "A glance over its membership list confirms the belief that the best inventive and mechanical brains in the country, both in and outside of the automobile industry, are associated in the Society of Automobile Engineers. These men have given their time and service unsparingly and it would be difficult to gage the value of the work they have done. Many of them are at the head of vast industries. It would be almost impossible to put a monetary value on their time which has been given so freely to committee work of the Society."

What the development of the next decade or of the next generation will be, none probably can conceive, but it is clear that the essential necessity of co-operative work will be more and more appreciated. No one can reach his attainable development intellectually or professionally without sharpening his wits through much contact with men in and out of his own station of life. The wise men say that those who give shall receive, and it is indicated strongly that those who do not give to others in some material degree the benefit of their practical and scientific experience, never receive as much as they could and should otherwise; and they can never be assured of being right in deductions as to data which they endeavor tenaciously to hold exclusive to themselves.

Building for the Future

The members of the S. A. E. and the automobile industry and the public in general may well be grateful to the founders of the Society from small beginnings, and to the splendid men who from time to time in recent years have served most effectively and gratuitously in devotion to an idea—the conception of what a properly organized association of talented engineers can and should do toward facilitating the evolution of mechanical transportation in the most efficient manner, toward assisting the younger men in the profession (with whom the future of the industry rests) in a spirit of true altruism, and toward the establishment of the best principles of ethics throughout the fabric of automobile design, production and maintenance.

Society's Services Summarized

The Society of Automobile Engineers has been aggressive, and produced indisputable evidence in many concrete instances, of valuable service rendered which no other body has rendered or perhaps could render. It has brought order out of chaos in the marshalling of group after group of innumerable details of motor car fabrication. Through logical forcefulness of facts, the merit of its standardizing and scientific work is clear to the man who runs.

The FORVM

A SYMPOSIUM ON THE POSSIBILITIES, ADVANTAGES AND DISADVANTAGES OF TWO-STROKE TYPE OF MOTOR—THE IDEAL OBJECTS OF A DIFFERENTIAL—OTHER VIEWS ON SUBJECT

Thinks Time Element Prohibits Two-Stroke

By Finley Robertson Porter
President, Finley Robertson Porter Co., Inc.

IN reference to the return of the two-stroke engine, I can hardly believe that this will ever amount to anything. My impression is that the future motor will be rated by a cubic inch displacement per minute, or firing strokes per minute. In view of the high piston speeds now possible with apparent safety, the greatest factor to be dealt with seems to be the time sufficient to get the gases in and out without a corresponding lowering of the brake mean effective as the result of back pressure. If one would be satisfied with a comparatively low brake M.E.P., piston speeds could be increased without any detrimental results.

In view of this situation I cannot understand a two-stroke engine as being at all possible, because of the fact that the one controlling factor as mentioned above is divided by two, as compared to motor revolutions, and the intake and exhaust periods in relation to one cycle are likewise divided. The answer seems to be a very low power ability and likewise a high heat flow to both the cooling medium and exhaust.

Personally I have never heard of the two-stroke engine even approaching efficiency, so that, unless some decided improvement is brought about, I do not anticipate any great increase in the use of the two-stroke engine.

Two-Stroke Problem Grows Harder

By A. F. Milbrath
Secretary and Engineer, Wisconsin Motor Mfg. Co.

CONCERNING two-stroke engines, the writer does not believe these will come in to any extent in the near future, as it is difficult to get the certain operation out of the two-cycle which the four-cycle will give. One of the main causes of this is the fact that it is impossible to hold the crankcase compression in these engines for any length of time. As soon as the bearings wear slightly, the gases will leak through the bearings and will thus cause weak explosions in the cylinders affected. In order to get good economy, compressions have been going up the last year, and with the higher compressions, it would be more difficult to prevent leakage than with the lower pressure.

Good Two-Stroke Probably Complicated

By F. E. Watts
Chief Engineer, Hupp Motor Car Corp.

I HAVE been rather out of touch with the developments of the two-stroke engine for several years past. I believe, however, that the common form of two-stroke engine using crankcase compression has only the very apparent advantage of simplicity to recommend it for pleasure car work. Its more prominent faults are that it is not possible to fill the cylinders as completely with a fresh charge as in the standard type of four-stroke engine; and, as it is practically a constant compression engine, the charge drawn in is mixed with a large amount of burned gas left from the preceding explosion. This, together with a considerable portion of the fresh charge which passes into exhaust, in most designs, results in very poor fuel economy, and in comparatively slow working speed as compared with recent four-cycle practice.

These same faults are found to a greater or less extent in ordinary modifications of the crankcase compression type, such as the two-diameter piston engines. These modifications, moreover, are even more difficult to get into good running balance than are the ordinary crankcase compression types, which are noticeably more difficult to balance than the standard four-cycle type.

Apparently, the only way to get efficiency in the two-stroke engine is to forget the maximum cheapness. Successful engines can be built by using separate pumps and pre-compressing the charge. Fuel injection with high compression is probably a possibility for commercial cars and for gas-electric cars.

It is, however, very likely that none of these engines may prove attractive enough to be manufactured in quantity, for it is by no means certain that when a two-stroke engine is produced having the flexibility and fuel efficiency of a modern four-stroke engine, that it will be simpler, lighter or cheaper to build than the latter.

The recent book of D. A. M. Low, published by the Temple Press Limited, London, England, covers the development and the possibilities of the small two-stroke engine in a very enlightening and interesting manner.

Thinks Subject Worth More Study

By C. W. McKinley
Engineer, Willys-Overland Co.

THE ordinary type of three-port, two-stroke motor has several points to recommend it on first glance. These are simplicity, due to lack of moving parts, and power due to the two impulses to the four-stroke motor one.

These apparent advantages, however, are more than balanced by operating conditions. For instance, up to the present time no two-stroke motor has been produced successfully that will equal the performance of the four-stroke motor as regards flexibility. While I believe it possible to accomplish

this result, it would be by the action of valves and ports in addition to the simple three-port type. These additions, however, would offset the original advantage of the three-port, two-stroke motor.

Secondly, as regards power. The apparent gain is in the best instances about 40 per cent. The consumption of fuel rises to a great degree and the amount of fuel required to produce the same power with the two-stroke as with a four-stroke, would be 30 to 60 per cent greater than with a four-stroke. I believe, however, that if a thorough attempt was made to improve the two-stroke motor it would be well worth while.

Perfecting Two-Stroke Spoils Simplicity

By E. G. Gunn

Chief Engineer, Premier Motor Corp.

I HAVE followed the recent development in two-stroke engines, and while although the underlying principle is simpler in the case of the two-stroke engine, it does not appear to me that the game is worth the candle; in other words, by the time the various devices are put on to make the two-stroke motor operate in a satisfactory manner, a great deal of the attractiveness is lost.

Efficiency Demands Air Pump

By E. Gruenwald

Chief Engineer, Moline Automobile Co.

THE efforts which are being made to bring the two-stroke engine for motor vehicles back to life again, is a task which in my opinion, does not promise ultimate success.

I personally feel that efficient engines of the two-stroke type are only possible if the gases are controlled in the same manner as in the large stationary two-stroke engines, necessitating considerable complication and weight for the automobile engine, while the two-stroke engine without the auxiliary air pump is not efficient enough to compete with the high-grade four-cycle engine of to-day.

I am very much interested to learn of the views of other engineers on the same subject.

Limit of Engine Power Is Heat Developed

By W. R. Strickland

Chief Engineer, Peerless Motor Car Co.

IN regard to agitation in favor of two-stroke engines, I am of the opinion that two-strokes and two-cycles are in somewhat similar relative position, that is, they both tend to over-heated conditions for the development of the extra power which can be more simply and easily obtained by an enlargement of bore or stroke of the present simple design.

The piston design, especially, necessary for two-stroke motors would seem to be impossible from the present standpoint, as you are familiar with the space utilized on the top of our present pistons where increased clearances are necessary to prevent seizing before we reach the point sufficiently cool for natural clearances to be used.

The skirtings even now, where the natural clearances are used, are none too long to carry away the heat from the combustion end and, where two stroke pistons are designed, they have generally resorted to water circulation in order to reduce the size of the piston. I should say that the complications are more than four-fold without attendant compensation.

Two-Stroke Needs Good Gasoline

By F. N. Nutt

Chief Engineer, Haynes Automobile Co.

PERSONALLY, I never did have any love for, or patience with, the two-stroke motor and my experience with it was at a time when gasoline analysis was much different and better than at the present time. I am afraid that the present low-test gasoline will cause considerable trouble with the two-stroke motor.

The Ideal Objects of a Differential

By Lewis H. Scurlock

President M. & S. Gear Co.

BEFORE commencing a discussion of this subject, let it be said that the application of the power to the motor through the wheels to the ground, up to the present time has been largely a matter of theory and guesswork as no one has as yet been reported who could show the actual measurements of the horsepower delivered to the individual driving wheels of a motor under actual road traveling conditions.

The only real facts which we may feel safe in believing are those which stand out most plainly and apparent as obviously true, such, for instance, as where one wheel is permitted to spin in a mud hole or on a slippery pavement.

Until such time as actual measured tests are made to determine the amount of power delivered to each of the rear wheels of an automobile on the road the question of power distribution to the rear wheels will remain somewhat in doubt as to the actual figures.

Let us see what we would require of an ideal differential.

First, a positive pull on both driving wheels when car is traveling in a direct line ahead.

Second, the power equalized on both driving wheels when the car is turning, proportionately to the resistance offered to each of the wheels.

This would give us the following results:

First, a positive drive on both rear wheels.

Second, power equalized on both rear wheels when car is turning, according to the resistance offered to the driving wheels.

Third, increased efficiency of the motor of the car by virtue of the application of all its power which is capable of being absorbed by the resistance of the traction.

Fourth, less wear on the rear set of tires, it being impossible for one wheel to skid or spin in mud holes or sand.

Fifth, the elimination of much of the skidding on wet streets and doing away with the side sway of the car.

It would seem that other minor advantages would come from an ideal differential which would accomplish all of the above results.

Bevel Gear Differential Inefficient

Let us refer to the defects of the bevel and spur type of differential, both of which have been in common use, and we find from a mechanical standpoint that these differentials are both as good as could be desired, but find them weak from a functional use.

First, the bevel gear differential will permit the spinning of one wheel if it encounters less resistance than the other

wheel and will lose the power of the motor through the spinning wheel.

Second, it permits unequal differential action when the resistance to either of the driving wheels is materially different.

From these defects it may be observed that the ordinary type of differential can cause a lot of trouble such as getting stuck in mud holes, wearing out of your tires, skidding of wheels which causes car skidding and dangerous accidents, unnecessary use of gasoline, and all of the evil effects which go with the spinning of one wheel and the standing still of the other when unequal traction is encountered. Thus it would seem that had the present type of differential been deliberately designed to accomplish these defects it would have been very successful.

Defects of the Solid Axle

The defects as well as the advantages of the solid axle have been heretofore set forth too elaborately to need further discussion except to add some of the defects which have not as yet been mentioned.

The differential lock which has been used extensively by some of the largest manufacturing concerns and discarded as impractical seem to offer all the advantages of an ideal differential for the solid axle, and at the same time provide for differential action when necessary. The differential lock used to lock together the driving bevel gears of a differential gave the desired effect of a solid axle when pulling out of a mud hole or getting a load out of some place where going is hard, but it happened so frequently that the driver failed to release the lock. Then, when turning a corner or taking up the uneven road play something always broke, which demonstrates the fact beyond question that the strain from a solid driving shock such as was the result when the differential was locked, brought extraordinary strains on different parts of the truck principally, however, in the rear axle, to such an extent that this idea of using a differential lock has been abandoned by most of our manufacturers, although we believe that some few are still holding on to them waiting for the ideal differential.

The experiments made on the solid axle in New York would be valuable were it not for the fact that they were made on good macadam streets and in the season of the year when there was snow or rain on the macadam, which made the retard slipping action on the rear wheels very easy and not condusive to tire wear. Undoubtedly were this experiment conducted under road and travel conditions as exist in hundreds of our inland cities, where good pavements are scarce, it would not have proved quite so satisfactory. The experiments with racing drivers have led most of them to prefer using even the ordinary differential in preference to the solid axle as it makes the car too hard to control on the track.

Turning Corners Unimportant

The statement that a differential is required only 1 per cent of the time while a straightaway pull is required 99 per cent of the time is largely theory and is not based on actual conclusion. Differential action is required many times in road travel when you are not turning corners. The turning of corners is one of the smallest requirements of a differential. It is the constant change of direction and the uneven road play under practical road conditions that requires differential action.

We believe that our spiral gear differential, known as the M. & S. comes as near meeting the *ideal* requirements of the differential as it is possible to conceive at this time. This differential applies the power to both wheels under all conditions and at the same time gives the necessary differential action when turning a corner for the following reasons:

First, the internal gears of the M. & S. differential are irreversible from the power applied by the motor to the driving gear.

Second, the internal gears of the M. & S. differential are reversible from the roll of the wheels in coming in contact with the ground giving the necessary differential action.

These two salient features cover the action of this differential and give the advantages of the solid axle as well as all the advantages of a differential. Unlike the bevel gear differential the M. & S. gives equalized differential action in turning a corner or taking up uneven road play. Many thousands of the M. & S. differentials on the Jeffery quad and light cars are now in use, and it has not been found necessary to increase the size of the axle drive shafts in any instance. Theoretically, it is not possible to apply more than 70 per cent of the entire power of the motor to one wheel even though the other wheel be on soft or slippery ground, and by the steady application of this power to the M. & S. it would not seem possible to deliver as great a shock load to the differential as it would be to a bevel gear differential where one wheel could be spinning rapidly and suddenly checked.

In Detroit there is now being completed a set of instruments for testing the actual power delivered to road wheels under actual road conditions which will undoubtedly determine plainly many of the questions with reference to the application of power to the rear wheels and give some actual facts and data on which to base a conclusion.

That there is a lack of authentic data with reference to power distribution is evident, and it is hoped these experiments will help to clear up the situation and give us facts as a basis on which to prepare future data as to power distribution under actual road traveling conditions.

Built Friction Drive Without Differential

By Charles Guernsey
Engineer, Service Motor Truck Co.

WE have read, with considerable interest, the discussion in THE AUTOMOBILE dealing with the possibilities of eliminating the differential. There are a number of things which have made good in practice which do not look good on paper, and this may be such a proposition.

However, the writer doubts its advisability. He was, at one time, connected with a company making a friction driven truck, in which a separate friction wheel delivered power to each rear wheel. There was no provision made in the job for differential action. In the hands of a capable driver this transmission gave very satisfactory service, but if someone got hold of it who would not release the power in going around a corner a great deal of trouble was experienced on account of breakage of various parts, which trouble we attributed entirely to the lack of a differential.

It is the writer's belief that it would be a constant experience of the same kind of trouble with axle shafts, etc., if the differential be eliminated.

Thinks Differential Doomed

By H. L. Palmer
Director of Sales, Standard Motor Truck Co.

WE believe there is much to be gained by the elimination of the differential although we are not having any trouble along this line, but always have been great believers in simplicity and our experimental department has been trying to eliminate the differential and think that they will do so by construction which is not at present open to public discussion. We believe that the day is not very far distant when this construction will be eliminated from the automobile.

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Making History

EACH successive annual summer meeting of the S. A. E. is a milestone in the progress of automobile science. To every such meeting a number of members go with unsettled minds. Conversation, discussion and the chance remarks of others help to determine a course of action, so that the previous hesitancy is replaced by a complete confidence.

To a greater or lesser extent this happens to every individual engineer who attends these great gatherings. We all depend to an immense extent upon others, for modern man is a helpless creature by himself. Our civilization has become so complex that the accumulated experience of thousands is necessary for us previous to making any forward step whatever in science or in engineering.

From the beginning of time till a century ago, mechanical knowledge progressed with extreme slowness, because of the difficulty of transportation; men could not get together, and individuals of engineering bent were forced to work out things alone and unaided. The automobile industry has had a century of growth in 10 years owing to the ever-existing readiness of the engineers to get together. It is not too much to say that the summer meetings of the S. A. E. have been responsible for doubling the pace of development, that had it not been for these gatherings, the car of 1917 would have been advanced no further than the car of 1914.

Mammoth Mergers

THE formation of a $300,000,000 corporation to absorb a large proportion of the automobile industry of America is an event of commercial magnitude seldom if ever equalled in the history of business. Furthermore, there seems good reason to believe that the cause is a new one, that the object of the combination differs somewhat from that of previous amalgamations in the automobile and in other fields.

Co-operative buying is one of the main objects, if not the chief object of all. It is the ambition of the leaders in this latest of mergers to have so big and so rich a body that it can control every stage in the production of an automobile, commencing from the digging of the ore from which the steel is made.

In the cocoa business for years past there have been big corporations owning plantations and mills, so making the cocoa trade self-contained from the planting of the ground to the delivery of the finished product to the consumer. Never before has a manufacturing industry of anything like the complexity of the automobile business attempted an A to Z control of this kind.

To the consumer the effect should contain more of good than of evil. Immense economies in production cost enable huge profits to be made without raising the price of the article; they allow the price of the product to be cut without cutting the profits. Absolute monopoly in these days is almost impossible, with any complex thing it is quite impossible, so a big company may have immense power for economy without any power to inflate price. Probably dealers and users will discover nothing different in their circumstances due to the combination, which should tend to stabilize the value for money now obtainable.

Aviation Engineering

THAT the engineering of aircraft is closely allied to that of road transport vehicles has long been realized, and the tendency has lately been for the two branches to come closer together rather than to separate. This is because automobile engineering experience prepares a man better than anything else for a subsequent divergence into the newer field.

Thus we see automobile engineers becoming more and more interested in aviation, and aeroplane builders more and more confident in the ability of automobile firms to build their engines and help them with the mechanical detail of their planes.

There is no doubt but that the aviation industry of America is going to be a large and important one. Just now the only customer is the Government, but governments the world over are going to absorb a very large output for years to come. Meanwhile, there are many thinking men convinced of the future value of aeroplanes for mail-carrying and even for rapid passenger traffic between certain points. So, cutting out the enthusiasts who foresee the privately owned plane as a pleasure machine, there is ample encouragement to enter the field.

S. A. E. Summer Meeting Program

Details of Activities for Each Day on Lake Cruise Session, June 12-16

Monday

Meeting the incoming members and guests. Registration headquarters—Pontchartrain Hotel.

8:30 a. m.—*First Business Session — Observation Deck.*

9—*Automobiles to be available for factory visiting, sight-seeing and shopping.*

11:30—*Lunch to be served at headquarters, in the ball room of the Pontchartrain Hotel.*

2 p. m.—*Steamship Noronic Sails.*

2:30-5—*Promenade, Observation Deck.*

3-5—*Standards Committee Meeting—Main Deck.*

6-8—*Dinner—Bugle at 6 and 7.*

8:30—*First Business Session.*
President's Address,
Future Scientific Development of the Automobile—C. F. Kettering.

11-12:30—*Dancing.*

Tuesday

7-10 a. m.—*Breakfast—Bugle at 7:30 and 9.*

9:30-12—*Professional Session—Observation Deck.*
Differential Substitutes—D. D. Ormsby.
High-Speed Engines—A. P. Brush.
Car Performance—Prof. D. L. Gallup.
Possibilities of the Constant Pressure Cycle—A. B. Browne and Herbert Chase.
Straight-Side vs. Clincher Type Pneumatic Tires —J. E. Hale.

12-2 p. m.—*Lunch—Bugle at 12 and 1.*

2—*Arrive Mackinac Island.*

5:30—*Noronic Sails.*

6:30-8:30—*Dinner—Bugle at 6:30 and 7:30.*

8:30—*Entertainment—Pennsylvania Section.*

9:15—*Entertainment—Cleveland Section.*

10—*Dancing Contest.*

Wednesday

7-10 a. m.—*Breakfast—Bugle at 7:30 and 9.*

7:30—*Arrive at Killarney.*
Fishing, Sports and Trip on Waubic.

12-2 p. m.—*Lunch—Bugle at 12 and 1.*

6-8—*Dinner—Bugle 6 and 7.*

8:30-10:30—*Entertainment.*
Detroit Section.

10:30-12:30—*Dancing.*

Thursday

5 a. m.—*Sail from Killarney.*

7-10—*Breakfast—Bugle at 7:30 and 9.*

9:30—*Professional Session—Main Deck.*

Bronze Alloys for Automobile Construction—W. M. Corse and G. F. Comstock.

Recent Aeroplane Engine Developments—Neil MacCoull.

Mechanical Transport Mobilization—A. J. Slade.

Automobile Experiences in the Great War.—W. F. Bradley.

Automobile Engineer and Preparedness—H. E. Coffin.

12-2 p. m.—*Lunch—Bugle at 12 and 1.*

2-4:30 p. m.—*Standards Committee Reports and Transaction of Adjourned Business—Observation Deck.*

4:30-6:30—*Owen Sound.*

6-8—*Dinner—Bugle at 6 and 7.*

8:30-10:30—*Entertainment*

Metropolitan Section.

10:30-12:30—*Dancing.*

Friday

7-10 a. m.—*Breakfast—Bugle 7:30 and 9.*

9:30—*Professional Session—Observation Deck.*

Crystallization in Cold-Drawn and Pressed Steel Parts—R. H. Sherry.

Kerosene vs. Gasoline in Standard Automobile Engines—Prof. C. E. Lucke.

Engine Fuels of the Next Decade—Dr. W. F. Rittman.

Open Discussion on Fuel Situation.

12-2 p. m.—*Lunch—Bugle at 12 and 1.*

2—*Professional Session—Observation Deck.*

Large Single vs. Dual Tires for Truck Rear Wheels—W. H. Allen.

Farm Tractors—C. M. Eason.

Refinements and Generalities in Truck Design.—H. D. Church.

Dynamics of Vehicle Suspensions—Dr. Benj. Liebowitz.

6—*Arrive Detroit.*

Overland, Hudson, Chalmers, Auto-Lite and United Motors in Monster Merger

New Corporation Second Only to U. S. Steel in Magnitude Formed with $223,000,000 Capital—Total Capital May Be Increased to $313,000,000

DETROIT, MICH., June 5—Two hundred and twenty-three million dollars is the capitalization of one of the biggest mergers in the history of commerce. It will cause the automobile industry to rank next in order to the steel trade, as only the United States Steel Corp. will have a larger amount of stock.

The new Willys-Durant merger of four automobile companies, with a substantial interest in a fifth, will start off on the basis of $223,000,000 of capitalization, it was announced yesterday.

It is understood that the name of the new combine will be the American Motors Co., with $70,000,000 preferred stock of $100 par value and 2,000,000 shares of common with no par value. The entire preferred stock issue will probably be apportioned among the companies entering into the merger, with none being offered to the public. Only a limited amount of the common stock is to be sold to the public at large, and at the present time it seems likely that this will be largely over-subscribed.

The company, which represents a union of the Willys-Overland, Hudson, Chalmers, Auto-Lite and United Motors Corp., the latter a combination of five accessory companies, which will supply parts for the cars made by companies in the merger, will make its début with $73,000,000 of 7 per cent preferred stock and 2,500,000 shares of common without par value. As it is proposed to sell the common stock to the public at 60, the capitalization represented by this stock is $150,000,000. The parent company will not be cramped by its capital limitations, however, if the management decides to expand, for the charter provides that the number of common shares may be increased to 4,000,000, which at the issue price would make the total capitalization $313,000,000.

Fisk a Possibility

It was said yesterday that no additional companies are being considered at this time as possible members of the new Willys-Durant family, with the exception of the Fisk Rubber Co., which may be taken in if terms can be agreed upon with holders of the large blocks. L. G. Kaufman, who has been handling the financial end of the merger, said that if the Fisk is purchased it will not be necessary to call upon any of the additional authorized stock, as there will be sufficient cash in the treasury to supplement the stock issued in payment.

John N. Willys, who is understood to have received $90,000,000 for his controlling interest in the Willys-Overland Co., will be paid in preferred stock and cash. It is said that he receives $45,000,000 in cash. He and his associates in Toledo have agreed to take a one-fourth interest in the 2,500,000 shares of common stock to be offered for sale. All of the $93,000,000 of 7 per cent preferred stock will go to the venders of the companies entering the combination.

William Salomon & Co. will head the underwriting syndicate to handle the common stock. Associated with them in the management will be Dominick & Dominick, who underwrote the recent Durant flotation of United Motors; J. S. Bache & Co., who underwrote the Durant Perlman Rim Corp., and W. W. Laird of Wilmington. The powder millionaires of Wilmington will take a very large interest in the company.

Other Mergers Rumored

Simultaneously there are rumors of a possible combination including Chevrolet, General Motors, Packard, Edmunds & Jones and a number of accessory manufacturers. It is claimed that the Timken company may line up with either the Willys-Overland or the Chevrolet group and that it is even possible General Motors, the Chevrolet group and the Willys-Overland group may enter into working agreements which will be almost the equivalent of a single combination.

The reason for these suggested mergers is to be found in the abnormal state of the raw material market. Every large manufacturing concern this year has suffered more or less severely owing to the unexpected rise in the price of steel and many other commodiities. It is felt, therefore, that the best insurance against fluctuations in the cost of raw materials is either for the automobile plants to establish steel mills, etc., of their own or to form combinations of such strength that they can take over existing steel mills, thereby absorbing them into the merger virtually if not actually.

Howard E. Coffin, vice-president of the Hudson Motor Car Co., is the authority for the statement that no automobile manufacturer is wealthy enough or consumes sufficient to make it worth his while to establish an individual steel mill, but that if the automobile industry divided into two or three groups it would be entirely self-supporting from the extraction of the ore to the finished article.

The situation at present is the existence of the General Motors Corp., of which W. C. Durant is president, the United Motors Corp., of which W. C. Durant is president, and the new corporation merging the Willys-Overland, etc., of which John N. Willys will be president. It is firmly believed that there will be at least a close working agreement between the new Willys merger and General Motors. If this proves actually to be true it will mean that W. C. Durant and John N. Willys will jointly control the great bulk of the automobile business of America.

THE THREE COMBINATIONS ARE:

1. New combination includes:
   Willys-Overland Co., Toledo, Ohio.
   Chalmers Motor Co., Detroit.
   Hudson Motor Car Co., Detroit.
   Electric Auto-Lite Co., Toledo.
   United Motors Corp. (Group No. 2).
2. United Motors Corp. includes:
   Dayton Eng. Lab. Co., Dayton, Ohio.
   New Departure Mfg. Co., Bristol, Conn.
   Hyatt Roller Bearing Co., Detroit.
   Remy Electric Co., Detroit.
   Perlman Rim Corp., New York.
   (General Motors, United Motors Corp. and Chevrolet Co. linked together through the common presidency of W. C. Durant.)
3. General Motors Co. includes:
   Buick Motor Co., Flint, Mich.
   Cadillac Motor Car Co., Detroit.
   Oakland Motor Car Co., Pontiac, Mich.
   Olds Motor Works, Lansing, Mich.
   Jackson-Church-Wilcox Co., Jackson, Mich.
   Weston-Mott Co., Flint, Mich.

The five companies which are merged into the new corporation have unfilled orders on hand amounting to $8,000,000,

are sold out for over a year in advance, and have contracts for supplies to provide this output.

The officers of the Motor Products Corp. are W. C. Rands, president; C. F. Jensen, president of the Vanguard company, vice-president and supervisor of purchasing; H. H. Seeley, head of the Superior company, is vice-president and sales manager; D. B. Lee, vice-president of the Diamond company, is treasurer and general manager; M. L. Brown, treasurer and manager of the Universal Metal Co., is secretary. The board of directors consists of these men and R. R. Seeley, who is to be the Motor Products Corp. production manager.

Company to Branch Out

W. C. Rands states that while it would appear that windshields would be one of the most important products of the new combine, the intentions are to branch out into several other fields of automobile parts manufacturing. It is planned to build a large drop-forge plant and to add a screw machine department, so that in the end windshield making will only be about one-third of the concern's total activities. Later it is intended that the somewhat scattered plants are to be brought together in one very large institution here, building plans looking to this end already being under way. Some of the concerns in the combine have Canadian plants also, and these will be concentrated eventually to adequately care for business across the border.

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J. K. Stewart Dead

NEW YORK CITY, June 2—John K. Stewart, president of the Stewart-Warner Speedometer Co., Chicago, Ill., died to-day at his home, 12 East Eighty-seventh Street, this city, in his forty-seventh year.

Mr. Stewart became president of this company in December, 1913, at the time of the Stewart-Warner merger, when that company purchased the plant and patents of the Stewart & Clark Mfg. Co., maker of the Stewart speedometer, and also the plant and patents of the Warner Instrument Co., Beloit, Wis.

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Chrysler Resigns from Briscoe

FLINT, MICH., June 3—Walter Chrysler, who has ably supervised the manufacturing and production departments of the Briscoe Motor Co., has tendered his resignation following the resignation of C. W. Nash as president of General Motors. Nothing has yet been given out regarding Mr. Chrysler's future plans, nor as to who his successor will be. Mr. Chrysler is regarded as one of the foremost production men in the industry and has had much to do with the remarkable expansion and growth of the Buick factories.

Big Parts Makers Combine

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Five Companies from Detroit Territory Merge as Motor Products Corp.

DETROIT, MICH., June 3—On the eve of the formation of other great mergers in the industry comes the announcement of the completion of plans whereby several large parts makers in other lines located in Detroit and vicinity are to be combined under the name of the Motor Products Corp., with a capitalization of 100,000 shares of no par value and with W. C. Rands, head of the Rands Mfg. Co., this city, as president. Incorporated under the laws of New York and with a main office in New York City and headquarters here, this corporation as at present outlined takes in the Rands Mfg. Co., the Vanguard Mfg. Co., the Diamond Mfg. Co., and the Universal Metal Co., all of Detroit, and the Superior Mfg. Co., Ann Arbor, Mich.

The Rands Mfg. Co. is a very large concern making at the present time windshields, tops and steering wheels, having begun this activity in 1900. Vanguard makes a specialty of windshields, and has been located in Detroit for about 3 years, during which time it has shown a remarkable growth. The Diamond Mfg. Co. makes metal stampings, such as radiator fittings, radiator shells, hubs, hub caps, manifolds and tubing. In a similar line is the Universal Metal Co., this concern having a large tube mill and making a variety of metal parts as well. The Superior Mfg. Co. is also a big windshield maker, besides doing business in other accessories necessary to motor vehicles.

Stock Oversubscribed

It is understood that the stock of the new holding company will be put upon the market very soon. It is said to have been heavily oversubscribed, there being 100,000 shares of no par value. The underwriting has been done in New York.

Seventy thousand shares of its stock are now being issued, 5000 shares of which are to be designated as Class B stock and have full voting power and the remaining 65,000 shares to be designated as Class A stock and will have full voting power, but will be identical with Class B stock in all other respects. The articles of incorporation will provide that the voting power of Class B stock will pass to all stockholders alike in the event of the failure of the company to earn a minimum of $5 per share per annum for any two consecutive years on all the then outstanding capital stock.

The syndicate, which has been formed by J. S. Bache & Co., is to continue in force for a period of 6 months, but may be extended at the option of the managers for a further period of 60 days.

The stock of the corporation was offered for subscription at $74 per share. Of the total 70,000 shares, 20,000 shares were given to holders of the stocks of the five companies that constituted the merger in part payment for their holdings, leaving 50,000 shares that were purchased by the underwriting syndicate.

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1917 Pierce Arrows To Be Sixes

BUFFALO, N. Y., June 3—The Pierce-Arrow Motor Car Co., Buffalo, is out with a direct announcement that it will adhere to the six-cylinder type of power plant in its 1917 output.

The six-cylinder type of engine, according to the company's announcement, is being continued solely because the company finds it most efficient. No question of price, no discussion of selling argument, enters into the verdict. The decision of the engineering staff follows a close observation of motor experiments and tendencies in the United States and Europe.

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Pullman to Make Truck

YORK, PA., June 2—The manufacture of a 1000-lb. light delivery truck is the latest venture of the Pullman Motor Car Co., this city. Two standard bodies are provided in its manufacture, the express type, selling for $750, and the panel type, at $775.

The truck is brought out on a special chassis which will hold maximum loads. The wheelbase is 114 in. The four-cylinder motor, 3¾ by 4¼ in., develops 32 hp. The valves are inclosed. The cooling system is of the thermo-syphon type and the radiator of the Pullman honeycomb style.

Left hand drive is provided, with center control and emergency brake lever forward of center. A 9¼-gal. gasoline tank is carried on the cowl.

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Van Deusen with Detroiter

DETROIT, MICH., May 31—Walter H. Van Deusen, formerly commercial manager of the E. R. Thomas Motor Co., and assistant general sales manager of the Chalmers Motor Co., and more recently district sales manager for the A. Elliott Ranney Co., New York City, has been appointed director of sales for the Detroiter Motor Car Co.

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McMullen Joins Chalmers Sales

DETROIT, MICH., June 1—B. J. McMullen, who was district sales manager on the Pacific Coast for the Willys-Overland Co., has been appointed an assistant sales manager for the Chalmers Motor Co.

S. A. E. Adds Tire Division

Military Committee Created—Truck Division Reorganized—Tire and Rim Division

NEW YORK CITY, June 6—At the April meeting of the standards committee of the S. A. E. in Cleveland it was suggested that a new division be added to deal with all matters in connection with tires and rims. This was discussed briefly by the standards committee and heartily approved. The council of the society at their last meeting in Indianapolis consequently decided to establish the new division to be known as the tire and rim standards division. H. L. Barton, production engineer of the General Motors Co., has accepted the position of chairman of the division and the other members represent the bulk of the tire and rim business. They are: W. H. Allen, C. C. Carlton, J. E. Hale, Russell Hoopes, C. B. Whittelsey, C. E. Bonnett, John Kelsey, J. V. Mowe, J. C. Mantenach, C. B. Williams, E. K. Baker, J. C. Cole and Christian Girl.

To Handle Tires and Wheels

The division will take over from the truck standards division questions relating to solid tires, rims and wheels and will also assume responsibility for the pneumatic tire and for pleasure car wheels and rims, thus carrying on the work of the old division which was dropped 4 months ago. It is believed that there is a real opportunity for standardizing passenger car felloe bands in the near future.

Aiding the Army

A special committee to be known as the military transport committee, was also appointed by the Council. This committee is not a part of the standards committee, but will co-operate with committees of other societies and with Government officials in the development of a military transport scheme. It will also have a close relationship with the truck standards division of the standards committee. It is composed of men who are not connected with any truck manufacturing companies. Its membership is as follows: C. F. Clarkson, Chairman; Geo. W. Dunham; E. A. Deeds; Henry Souther, and W. P. Kennedy.

The appointment of the military transport committee means the creation of a new body, as this committee will be independent of the standards committee, having the right to call upon the latter in work required. The recent conferences held between army engineers and truck makers under the auspices of the society prove conclusively how greatly the S. A. E. could help the military authorities in the creation of the military transport committee and provide a ready means of communication between the society and the military.

Reorganize Truck Division

Owing to the creation of the tire division and the fact that the truck standards division will probably be mainly occupied with military work the council decided to reorganize the truck standards division so that its membership consists solely of truck engineers connected directly with the manufacture. W. P. Kennedy, formerly chairman of this division, has been appointed a member of the military transport division and his place has been taken by H. D. Church, chief engineer of the truck department of the Packard company, the other members of the division being: B. B. Bachman, L. P. Kalb, W. T. Norton, Jr., A. L. Riker, W. R. Strickland, Geo. W. Smith, A. J. Scaife, F. A. Whitten, John Younger and E. R. Whitney. This increases the number of divisions of the standards committee to fourteen.

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24,000 Carloads of Automobiles Shipped in May

NEW YORK CITY, June 7—The National Automobile Chamber of Commerce at its monthly meeting to-day reported a return to normal conditions in shipments. May shipments amounted to more than 24,000 carloads, as compared with 15,392 in May last year. Conditions have so improved that the use of flat cars is no longer necessary.

The truck interests met to-day in convention, the meeting being attended by about forty makers with Windsor T. White, chairman. Policies of service and repair were adopted, so as to better the conditions of the truck users.

There will be no truck show this year.

The truck committee adopted at its meeting the definition of standard type chassis. Just what is included under the definition has not as yet been completed.

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108,286 Cars in Minnesota

ST. PAUL, Minn., June 3—Secretary of State J. S. Schmahl turned into the State treasury in May $11,902 covering automobile licenses at $1.50 each. The office issued 6900, at times at the rate of 500 a day. The total for the year is 108,286 cars.

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230,000 Registration For Ohio

COLUMBUS, OHIO, June 3—W. H. Walker, Ohio Registrar of Automobiles, in a recent report showed that 165,000 gasoline automobiles have been registered since the first of the year. The number of electrics registered is 4100, and dealers and manufacturers 2650.

Breaks Chicago-to-N. Y. Record

B. F. Durham in Chalmers 6-30 Roadster Covers 1047 Miles in 31 Hr.

NEW YORK CITY, June 7—Chicago to New York City in 31 hr. exactly, is the new record set by a Chalmers 6-30 fully equipped roadster, which negotiated in that time just 1047 miles. This record compares with that established by E. C. Patterson in his Packard 3-38 last July, when he covered 1015 miles in 35 hr. and 43 min. Thus Durham, who drove the record-breaking Chalmers, beat the old record by 4 hr. 43 min. and averaged 33.7 m.p.h. for the entire distance.

Durham and his observer, B. Harris, left Chicago yesterday at 3 a. m. and arrived here to-day at 11 a. m. The car went through the trip without any mishaps or punctures, the only stops being those for replenishment of fuel, oil and water. The car averaged about 14 m.p.g. on gasoline.

The route followed was through South Bend, Goshen, Kendelville, Bryan, Ohio, Fremont, Cleveland, Erie, Buffalo, Elmira, Binghamton, Middletown, Ft. Lee and into New York. The car reached Bryan at 8:30. Cleveland was made in 11.4 hr., a distance of 371 miles. The car up to this time averaged about 33 m.p.h. Last night at 8:47, the car left Buffalo and reached Middletown this morning at 8:30. Durham was relieved as driver by Al Walden from Cleveland to Elmira.

The car was equipped with A C spark plugs, Silvertown cord tires, Stromberg carbureter, Atwater Kent ignition, Westinghouse starter, and a Motometer.

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Fiat Factory in Hungary

BUDAPEST, April 18—A branch of the Fiat Automobile Works has been founded in this city by the local branch of the Anglo-Austrian Bank and the Fiat Works, Ltd., Co. of Vienna. The capital stock of the company is 1,000,000 crowns, $203,000. A factory building situated at Kelenfold, in the suburbs of Budapest, has been rented.

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Willys a Bank Director

BUFFALO, N. Y., June 6—John N. Willys, president of the Willys-Overland Co., Toledo, Ohio, was elected a director of the Third National Bank of Buffalo to-day.

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Jacoby Overland Service Director

TOLEDO, OHIO, June 6—K. R. Jacoby, who has been Toledo zone district manager of the Willys-Overland Co., has been appointed director of service, succeeding Herbert J. Finch.

Mid-West Section S. A. E. Meets

Re-elects Officers and Discusses Body Design, Trucks and Blakeley Motor

CHICAGO, ILL., June 3—The old officers of the Mid-West Section of the Society of Automobile Engineers were re-elected unanimously at the quarterly meeting of the section at the Chicago Automobile Club last night. Inasmuch as the section has been organized for less than a year, the first administrative year was less than 12 mo., and the old officers therefore were eligible. Those re-elected were F. E. Place of the Buda Motor Co., chairman; J. DeCou of the Thos. B. Jeffery Co., vice-chairman; Darwin S. Hatch, *Motor Age*, secretary; C. W. Stiger, Stromberg Motor Devices, treasurer.

Art and Body Design

The relation of Art to Motor Car Body Design formed the subject of a paper presented by W. B. Stout of the Scripps-Booth Co., Detroit, Mich., and in the discussion that followed the paper the point was brought out by Mr. Stone of C. Stone & Sons, Chicago, body builders, that there was room for great improvement by builders of chassis along the lines of making better arrangements for high-class, custom-built bodies. Such things as the angle of the steering wheel, the arrangement of the pedals, etc., often limited very much the scope of the body builder in working individual designs. To refute this a number of representatives of the car makers arose to the occasion with the statement that in most instances the angle of the steering column was changeable and the pedals were adjustable.

Buying a Truck

Henry Farrington, Thomas B. Jeffery Co., Kenosha, Wis., presented a paper entitled Problems Involved in the Choice of a Motor Truck, and discussed the points that the prospective truck buyer should take into consideration in selecting a commercial vehicle for his particular service. Mr. Farrington presented the advantages of the four-wheel drive as against the rear drive truck and in closing made a plea against manufacturers and salesmen rating the carrying capacity of their vehicles at too high a mark for all conditions of service, as it is the tendency of the user to load it to this capacity no matter what the operating conditions might be.

The Blakeley Motor

E. D. Blakeley of Sears, Roebuck & Co., this city, presented a description of a new type of high-compression engine of his own design which at present is applicable only for stationary use and is developed for small isolated plants, but which has possibilities of adaptation to truck service. Although of high compression it varies from the Diesel type, but like the latter is capable of running satisfactorily on very low-grade fuels.

Mr. Blakeley gave a demonstration of his design with a motor temporarily installed in the Automobile Club garage, in which he started it cold on kerosene and later ran it on very low-grade of oil and also on olive oil. The unusual features of the engine are that it has neither carbureter, electric ignition, or any special ignition features. Even with the low-grade fuel there was practically no smoke and very little odor. A description of the engine will be published in a later issue.

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Gamble Goes to Duplex Co.

NEW YORK CITY, June 4—D. E. Gamble, for the past 3 years designer and assistant chief engineer of the Herschell-Spillman Co., North Tonawanda, N. Y., has resigned to become chief engineer and superintendent of the Duplex Engine-Governor Co., this city. On May 26, the officers and department heads of the Herschell-Spillman company gave a theatre party and banquet in honor of Mr. Gamble at which Guy White, general manager, acted as toastmaster.

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Manson Succeeds Ilse on Jiffy

DETROIT, MICH., June 3—Frank H. Ilse, inventor of the well-known quick-acting curtain for automobiles, and president of the Jiffy Curtain Co., licensor of patent rights under Ilse's patents, has disposed of his interest in the concern to R. C. Manson, also connected with the company, and has retired as president. Mr. Manson becomes president and treasurer.

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Clarkson Comes to United States

NEW YORK CITY, June 2—J. B. Clarkson of the firm of Messrs. J. B. Clarkson & Co., Ltd., New Zealand, will arrive in this city June 15. Mr. Clarkson is one of the leading New Zealand importers of automobiles. He will first visit Chicago, which he will reach June 9. From there he will go to Detroit, reaching that city on June 12.

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Bindbeutel Leaves Motor Print

NEW YORK CITY, June 3—George T. Bindbeutel has resigned as editor of *Motor Print* to become active in the field of literary endeavor. John Chapman Hilder is his successor. Mr. Bindbeutel had been editor of *Motor Print* since December, 1914.

Norma Co. Plans New Factory

Buys 10-Acre Site at Elmhurst—To Build Four-Story Building

NEW YORK CITY, June 2—The Norma Co. of America, manufacturer of Norma high-precision anti-friction bearings, announces through its president, W. M. Nones, the purchase of a 10-acre factory site at Elmhurst, on the outskirts of Long Island City. The property fronts on Queens Boulevard and has a depth of about 1000 ft., abutting in the rear upon the main line of the Long Island Railroad, from which a siding will be built directly into the plant.

The company has, in 5 years, become prominently identified with the American automobile industry. Beginning as importer of bearings, the merit of its product gained quick recognition among the manufacturers of ball-bearing automobile accessories.

The latest move is made in response to an imperative demand for a still larger immediate output, with facilities for extension with the future growth of the business. The plans now under way provide for a four-story building, 70 by 350 ft., to be erected immediately in reinforced concrete. Every modern improvement will be embodied, looking toward the maximum of production efficiency. The location was determined upon, not alone for the excellent shipping facilities afforded but also for its ready access to the labor markets and home sections grouped around Long Island City—surface and subway lines running close to the property giving quick communication with neighboring Long Island towns as well as with Manhattan Island via the Queensboro Bridge.

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Chandler Employees to Share Profits

CLEVELAND, OHIO, June 2—A share in the profits earned by the Chandler Motor Car Co., this city, will be given to the employees of the company. It is indicated that a sum equal to 5 per cent on all wages paid, including overtime, commencing July 1, 1915, and ending June 30, 1916, will be paid with the July 20 payroll.

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Splitdorf Employees Get 10% Bonus

NEWARK, N. J., June 1—The Splitdorf Electrical Co., this city, has announced a 10 per cent monthly bonus to all employees to take effect at once. Over 1600 employees will be affected by the increase, which will amount to about $150,000 a year. The increase was given voluntarily on the part of the company.

Both piece-workers and day-workers will receive the bonus.

According to the bonus plan, every man or boy in the production end of the plant will receive the increase. A man employed at an hourly rate with a weekly wage of $20, at the end of the month will receive $8 extra. If he is a piece-worker the bonus will be figured on the total amount of wages he receives for the entire month.

Two Shifts Working

This is the first of a series of improvements in the working conditions of the employees, many of which will not go into effect until the completion of the new building of the company on Aug. 1, when many of the departments will be rearranged. At the present time two shifts are working at the plant, an open shop.

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Profit-sharing for Lee Rubber

NEW YORK CITY, June 2—A profit-sharing plan has been adopted by the management of the Lee Rubber & Tire Corp. Under this plan the important employees of the company will receive the benefit of a certain percentage which is to be taken from the net earnings over and above the $300,000 required for the payment of the present dividends of 50 cents regular and 25 cents extra quarterly. The plan provides for the distribution of the bonuses to the employees who are beneficiaries in proportion to the salaries received.

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Enlarge White Tractor Plant

CLEVELAND, OHIO, June 1—Rollin H. White has purchased 18 acres of land fronting on St. Clair Avenue, giving a total of 61 acres for the manufacture of tractors. It has been announced that the farm tractor plant is eventually to be a $1,000,000 plant.

The parcel of land just bought is directly in the rear of 43 acres fronting on Euclid Avenue, just east of the Baltimore & Ohio railroad's Bluestone quarry branch railway, which Mr. White purchased last fall. Mr. White has had plans made for gradual development of the tract and eventually expects to use the whole of it for factory buildings and storage yards.

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To Sell Great Western Co. Assets

DETROIT, MICH., June 5—Samuel Levy & Co., commercial auctioneers of this city, have purchased the entire assets of the Great Western Automobile Co., Peru, Ind., including all stock, material, real estate, etc. The service department of the concern will be continued for the time being but all material as well as the real estate is to be sold at auction within the next 6 weeks.

Kissel Brings Out New Six

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Hundred-Point Model to Sell at $1,095—4-32, 4-36 and 6-42 Discontinued

HARTFORD, WIS., June 3—The Kissel Motor Car Co., this city, has brought out the Hundred Point Six. It is a light six with a 3¼ by 5-in. motor, developing 52 hp. The price for the three-passenger roadster, four- or five-passenger touring body is $1,095. All-year bodies with detachable tops are made in sedan, coupe and town car styles at additional prices. The new car takes the place of the four-cylinder model which sold at $1,050, the 4-32 and 4-36 and the 6-42 models being discontinued.

The new model resembles in a general way the larger six-cylinder model, which will be continued. The block motor is L-head and its S. A. E. horsepower rating is 25.4. A few of the features are: Remy ignition and lighting; Kissel-Stromberg carbureter; three-speed gearset; Leak-Proof piston rings; Non-Gran bronze bushings; Timken bearings; Willard storage battery; and Stewart vacuum fuel feed system. The wheelbase of the new car is 117 in. and the tires are 32 by 4.

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Ten-Story Building for Packard in Long Island City

NEW YORK CITY, June 2—The Packard Motor Car Co., Detroit, has purchased the block fronting in Queens Boulevard, between Hill and Rawson Streets, Long Island City. This block adjoins the site now occupied by the Packard Building and it is to be utilized for the erection of a building for the use of the company. According to present plans the building will be ten stories in height and will be double the capacity of the present building between Hill and Van Dam Streets.

Plans are already prepared for another addition to the building in Van Dam Street and Queens Boulevard. It will be eight stories high and will contain 90,000 sq. ft. and its cost will be about $350,000. This addition will front on Van Dam Street. An addition costing $50,000 is just about completed, fronting in Hill Street.

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Sterns Tire & Tube Co. to Manufacture in St. Louis

ST. LOUIS, MO., June 1—Plans have been completed by Edward Sterns, president of the Efficiency Oil Corp., and the inventor of the Sterns automobile inner tube, to establish in this city a plant for the Sterns Tire & Tube Co.

The Sterns tube in appearance is like other inner tubes, but is constructed of a patented black rubber material which is said to be proof against punctures and blow-outs. It is said to be sold to motorists under a factory guarantee of 20,000 miles, at a price slightly higher than that charged for other tubes.

These tubes require 40 per cent less air in inflation and there is but a slight difference in their weight and the weight of other tubes.

It is the intention of the officials of the company to begin operation as soon as possible. The erection of a plant will be started on a 10-acre tract in the fall. This plant will adjoin the Efficiency Oil Corp. plant near Suburban Garden, in St. Louis County.

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Dodge Acquires More Land

DETROIT, MICH., June 2—Dodge Bros. continue to expand their plants, as evidenced by the purchase this week of property along Whiting Avenue adjoining present buildings. An effort is being made to close this thoroughfare, but so far this action has not been approved by the Hamtramck council, the Detroit suburb in which the Dodge property is located. Just what the new factory additions that will be erected on this land will be utilized for is not stated, but it is expected that the added floorspace will make possible the augmenting of the Dodge payroll by some 3000 men.

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Oakes to Add 50 Per Cent Floorspace

INDIANAPOLIS, IND., June 3—The Oakes Co., this city, maker of automobile horns, accessories and metal stampings, will build a one-story, reinforced concrete building alongside its present plant, giving it 50 per cent more floorspace. This building will also contain the new offices and will be ready for occupancy about Sept. 1.

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American Motor Plans Plant

PLAINFIELD, N. J., June 1—Tentative plans have been completed by the American Motor Co., for a factory group in this city. The main building will be 860 ft. long by 60 ft. wide and several smaller buildings are to be built.

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Jordan Takes Title to Land

CLEVELAND, OHIO, June 1—The Jordan Motor Car Co., this city, has taken title to a tract of 5 acres it recently purchased in East 152d Street, south of St. Clair Avenue. The first building, a $50,000 structure, now is being erected on the land.

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New Booklet on Willys-Knight

TOLEDO, OHIO, June 2—The Willys-Overland Co., this city, has issued its new booklet on the Willys-Knight car, in which it gives valuable information on the operation and construction of the Knight engine.

S.S.E. Co. Will Make Complete Car

$5,000,000 Philadelphia Company Formed To Build $5,000 Chassis

PHILADELPHIA, PA., June 3—The S. S. E. Co., a $5,000,000 corporation, composed of New York and Chicago capitalists, has purchased ground in the vicinity of the Hess-Bright plant in Kensington on which it will build a large plant for the manufacture of high grade automobiles.

The Organizers

In back of the new Philadelphia industry are: Victor Lee Emerson, designer of the Emerson engine, formerly president of the Emerson Marine Engine Co., and holder of a number of patents covering gasoline engines; E. E. Smathers, a New York capitalist of prominence, and C. B. Shaeffer, of Chicago and head of the Shaeffer-Smathers Oil Co. Mr. Emerson is general manager, Mr. Smathers president and Mr. Shaeffer vice-president. Temporary offices have been opened at Twenty-third and Chestnut Streets, this city.

Capital All Paid Up

The company was brought here through the efforts of the industrial bureau of the Philadelphia Chamber of Commerce, which is also negotiating for several other automobile plants. It is capitalized at $5,000,000 all paid up.

Buildings and equipment alone will cost close to $1,000,000 in addition to $250,000 already spent in getting the enterprise under way. The company owns and controls its own patents and will make everything going into the finished car except the tire and electrical equipment. This, Mr. Emerson said, is practically the first attempt anywhere to make a complete car. He estimates the value of the first year's output to be $5,000,000.

20-Acre Plant Site

The plant will be located on a piece of ground having a frontage of 2000 ft. on the main line of the Pennsylvania Railroad. It will cover approximately 20 acres. The buildings will be of concrete and steel and one story high.

Everything will be made on the ground floor under a saw-tooth roof. The equipment will be along most modern lines and will be electrically operated throughout.

It is claimed that the car will be the highest-priced of any made either in this country or in Europe. The chassis alone will cost in excess of $5,000. The body will be made in a number of styles and will be both open and closed.

None but the highest grade of workmanship and material will be used and the main idea will be to turn out a highly-scientific and flawless car regardless of price. Two of the principal features will be nimbleness and lightness. So pronounced is the latter feature that it will move while standing with a pressure of hardly more than 3 lb.

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New Gasoline-Saving Device Burns Crude Oil

DALLAS, TEX., June 2—T. S. Causey, 3303 Oak Lawn Avenue, Dallas, has invented a gasoline-saving device for an automobile which is claimed to burn crude oil successfully. Patents are pending for the device. It will be called a Thermal generator.

With gasoline selling at 20 cents per gal. and crude oil at 5 cents per gal., Mr. Causey believes he has an invention which will mean more to the automobile world than any other one thing.

"The proposition has been thoroughly tested and if it accomplishes nothing more than to save the fuel expense for gasoline cars it will prove the greatest boon the automobile world has known for some time," Mr. Causey says.

Speaking further of the device Mr. Causey said: "It controls the heat of the exhaust in a manner to get any amount of the heat desired and by it the gasoline is fed into a generator through a very fine needle valve. The oil comes into contact with the heated surface and is generated into gas, while at the same time the air is admitted in an automatic way that thoroughly mixes with the gas which is taken into the cylinders in the highest condition to produce the result needed."

Mr. Causey said that several big firms have offered him a handsome price for the exclusive rights on the device. He expects as soon as his patent is received to interest Dallas capital and establish a factory here. It will be several weeks, he said, before this can be done.

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May Issue Gasoline Cards in England

LONDON, ENGLAND, June 1—New regulations limiting the use of gasoline, which is scarce in England on account of the large consumption by the army and navy, will be issued next week. The regulations will take effect as soon as published.

It is said that the amount of gasoline used by the British army in France is equal to the entire consumption of the British Isles in times of peace. The use of automobiles on Sunday, except under special licenses, will be prohibited in the new regulations, which aim at the suppression of pleasure riding in the United Kingdom. It is probable that even the omnibus lines will be included in the new regulations. The use of gasoline cards, similar to the Berlin bread cards, is being considered.

To Open Mexican Oil Fields

Large Scale Development Under Way—Present Political Conditions Only Hindrance

TAMPICO, MEX., June 3—As an evidence that the larger foreign interests which have oil holdings in Mexico are confident that the present depressed condition of the industry will soon be relieved by an improvement in the political and financial situation of this country several large purchases of oil land leases have been made by them during the last few weeks. These transactions were given the official approval of the de facto government, as was recently decreed by Venustiano Carranza. It is stated here that the Texas Co., which now obtains a daily output of about 10,000 barrels of oil from its wells in the Tampico region, plans to enter the Mexico field on a big scale as soon as conditions here become more settled. It has obtained options on large tracts of oil producing land which it will develop. It is said that it also has under consideration the erection of a refinery here.

Big Developments

Development operations upon a scale such as was never before witnessed in any oil region in the world will be inaugurated in this part of Mexico as soon as assurances are felt by the investment interests that political and industrial peace has come to Mexico to stay and that the government will not overburden them with taxes and restrictions. It is authoritatively announced by the Lord Cowdray syndicate of London, Eng., which is operating in Mexico under the names of the Mexican Eagle Oil Co. and S. Pearson & Son, Ltd., that it has appropriated $75,000,000 American gold or £15,000,000 sterling for expanding its oil industry in Mexico. This vast sum will be spent in boring wells, laying pipe lines, enlarging its two refineries and the building of at least one additional, and the construction of oil-tank steamers.

The Mexican Petroleum Co., which is at this time the largest producer of oil in Mexico, has adopted tentative plans for the enlargement of its business that call for the expenditure of more than $50,000,000 gold, it is announced by its representatives here. This company recently closed a contract for supplying the Standard Oil Co. with 6,000,000 barrels of crude oil.

Many millions of dollars are to be spent in development work in the different fields of the Gulf coast region by the Pierce Oil Corp., the Dutch-Shell Trading and Transport Co., the Magnolia Petroleum Co., the Gulf Refining

Co., the Penn-Mex Fuel Oil Co. and other operating concerns. All of the older companies in Mexico are operating under concessions that were granted them by the Diaz administration. There is some uncertainty as to what standing these contracts have with the existing de facto government, but it is the opinion of oil men here that no attempt will be made to forfeit the concessions which have been standing so long.

No New Work

So far as undertaking new work in the different fields at present, nothing is being done. Everything in the way of opening up possibly new producing territory is at a standstill, pending the establishment of a stable government. The Mexican Petroleum Co. and the Mexican Eagle Oil Co. have a few rigs still at work putting down holes, and wells of enormous production have been bought in by both of these companies recently.

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German Gasoline Scarcity Stops Use of Private Cars

AMSTERDAM, June 1—Owing to the alarming scarcity of gasoline, the German authorities have practically put a stop to the use of automobiles, not only by private individuals, but also by members of the neutral Diplomatic Corps in Berlin.

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Report Reduced Manufacture of Carriages and Wagons

NEW YORK CITY, June 2—The inroads of the automobile into the carriage and wagon industry during the period from 1909 to 1914 were greater in respect to passenger vehicles than those used for business purposes. In 1909, according to statistics gathered by the United States Bureau of Census, carriages represented 53.2 per cent and wagons 39.7 per cent of all vehicles made, but in 1914 the proportion represented by carriages had declined to 47 per cent, while that represented by wagons had increased to 48.2 per cent.

293 Fewer Makers

In the preparation of the 1914 census of manufactures for the manufacture of carriages and wagons and of bodies, tops, cushions, hubs, felloes, spokes, wheels, and other materials used in the production of the complete vehicles, reports were received from 5320 establishments, which manufactured 1,187,002 vehicles of all classes, valued at $72,283,898. At the 1909 census there were reported 5613 establishments, with an output of 1,584,571 vehicles, valued at $94,037,900. The number of establishments thus decreased during the 5-year period by 293, the number of vehicles by 397,569, and the value by $21,754,002.

Gasoline Hearings June 12-13

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Federal Trade Commission Meets in Washington to Complete Its Information

WASHINGTON, D. C., June 3—An opportunity to explain the rise in the price of gasoline will be given various oil companies on June 12 and 13, when the Federal Trade Commission will hold a series of meetings in this city. The commission is investigating the price increase in gasoline under a Senate resolution. It is announced by the commission that a report will be submitted within a few days after the hearings.

Data Collected

The commission has sent letters to refiners, jobbers, pipe-line companies and crude oil producing companies throughout the country, asking them for any information they might care to present in addition to that already uncovered by the commission.

The Letter Sent

The letter sets forth that "It is the Federal Trade Commission's desire in every inquiry to secure all the facts and to draw the correct conclusions therefrom. To this end, having completed a preliminary tabulation and analysis of the data concerning the gasoline situation, as furnished by your company and others, the commission will now give to interested parties an opportunity for discussing the facts of the situation before reaching its conclusion."

Information Desired

The commission further sets forth in its letter that at the time of the hearings any company that may care to present, in addition to any information already submitted, any further information, it will be received and "any statement concerning your company's cost of production and the increase therein, as compared with the increase in prices, will be welcomed."

Investigate Competition

The commission also says it will be glad to have the various companies submit at the hearings a concise statement concerning competitive conditions in the petroleum industry, especially in regard to gasoline.

The commission's letter says in conclusion that "at this hearing the commission would desire to ask certain questions concerning these matters of your representatives, and to that end it is suggested that in case your company desires to appear it should be represented by officers thoroughly familiar with the executive, accounting, operating and marketing departments of your business."

It is believed in Washington that the gasoline quiz on June 12-13 will bring out a lot of interesting information about the high cost of gasoline and the real reasons for it.

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120 Trucks Displace 60,000 Oxen with Bulgarian Army

WITH THE BULGARIAN ARMY, MACEDONIAN FRONT, May 10—The motor truck has revolutionized transportation for the Bulgarian army. Figures have been given proving that each truck used by that army has been doing the work of 500 oxen and 250 wagons each day.

In the past the Bulgarian army has depended entirely upon the ox wagon for the transportation of its food, supplies and ammunition.

The truck carries a crew of two, is able to transport 3000 kg. at an average speed of 15 m.p.h. and runs 16 hr. a day if necessary. This means that each truck replaces, at a 16-hr. run, 180 ox wagons, 360 animals and about 200 men, as the ox wagon is in charge of one driver and carries an average load of 300 kg. and moves at a speed of about 2½ m.p.h. for 8 hr. each day. Considering that the truck, with a capacity of more than 3000 kg., is by no means rare at the Macedonian front, and taking into consideration the length of the various lines of supply, the average for each truck is 250 wagons, 500 animals and about 300 men.

These figures indicate that only about 120 trucks are necessary to permit the Bulgarian general staff to restore to the farms the 30,000 oxen which were furloughed some time ago. The change also liberated from the military service 30,000 men who had been drivers.

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Oxidation of Cylinder Oils in United States Bureau Paper

NEW YORK CITY, June 1—The United States Bureau of Standards has issued a pamphlet, Technological Paper No. 73, giving data relative to the oxidation of automobile cylinder oils, which has been made the subject of a recent study of that bureau.

The rate of oxidation of three oils when exposed to sunlight and air was studied, and the increase in weight, acidity, and carbonization value, as well as changes in the Maumene and iodine numbers and in the demulsibility were determined. Changes in the carbonization values of these three oils and of eight others, when heated for different lengths of time at a given temperature, and for the same time at different temperatures, were studied and are discussed very fully in the paper.

Durant Heads Gen. Motors Co.

Succeeds C. W. Nash, Resigned —W. C. Leland Takes Place of Strauss on Board

DETROIT, MICH., June 1—All doubt as to where the control of the General Motors Co. lies was dispelled by the election of W. C. Durant to the presidency at the meeting of the directors in New York City to-day, succeeding C. W. Nash, resigned. Coincident with this action came the election of W. C. Leland, vice-president and general manager of the Cadillac Motor Car Co., to the board of directors of the giant combine to fill a vacancy occasioned by the resignation of Albert Strauss, of the banking firm of J. & W. Seligman & Co., one of the banking interests which financed the General Motors following its difficulties several years ago and which was not favorable to the Durant faction. Another director, J. J. Starrow, of the firm of Lee, Higginson & Co., another of the banking interests opposed to the new control, has also resigned. Mr. Starrow did not attend the meeting.

Mr. Nash a Director

Mr. Nash remains a director of the concern, although his resignation as president comes as no surprise to those in a position to know, since dominance by the new interests is understood to have made his retention of the presidency untenable for certain reasons. Mr. Nash's connection with General Motors dates back to 1910, when, coming from the carriage and implement business, he was made vice-president and general manager of the Buick Motor Co., replacing Mr. Durant in that position. In 1912 Mr. Nash was elected president of the entire combine, and the remarkable growth and prosperity of General Motors is ample proof of his ability as an organizer and manager of so large a combination. He is regarded as one of the foremost figures in the industry today and he is at the present time closely identified with other interests in the field.

It is now believed that merging of General Motors and Chevrolet is forecast by this latest development. Mr. Durant's election to the presidency is his second incumbency in that office, and comes as a result of the regaining of control from the group of banking houses which carried the concern over its period of depression some years ago.

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Overland Common Stock Quartered

TOLEDO, OHIO, June 2—Sanction has just been secured from the State of Ohio and the New York Stock Exchange to reduce the par value of each share of common capital stock of the Willys-Overland Co., this city, from $100 to $25 a share. This change has been made in order to create a wider market and more general distribution of the stock.

The Willys-Overland stock, which has been steadily advancing during the past 6 months, reached its highest point during the past week, when it climbed to 276 3-4.

A notice of the reduction in par value will be sent to all holders of common stock, requesting a return of the old certificates in order that a reissue of the new paper can be made—four $25 par value shares being exchanged for each $100 par value share.

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Markets Steady

NEW YORK CITY, June 6—Prices of automobile materials last week were steady with few changes. Antimony dropped ½ cent a pound, lead went down 25 cents per 100 lb., and tin was $2.50 per 100 lb. lower.

The rest of the prices were unchanged. Fine up-river Para rubber fluctuated throughout the week, dropping to 65 cents a pound, it lowest quotation, and rising to 68 cents, its highest. Yesterday it closed at 66.

Daily Market Reports for the Past Week

Material	Tues.	Wed.	Thur.	Fri.	Sat.	Mon.	Week's Ch'ge
Aluminum, lb.	.58	.58	.58	.58	.58	.58	...
Antimony, lb.	.25	.25	.25	.24½	.24½	.24½	—.00½
Beams & Channels, 100 lb.	2.77	2.77	2.77	2.77	2.77	2.77	...
Bessemer Steel, ton	45.00	45.00	45.00	45.00	45.00	45.00	...
Copper, Elec., lb.	.28	.28	.28	.28	.28	.28	...
Copper, Lake, lb.	.28	.28	.28	.28	.28	.28	...
Cottonseed Oil, bbl.	10.90	10.95	10.93	10.78	10.85	10.90	...
Fish Oil, Menhaden, Brown, gal.	.55	.55	.55	.55	.55	.55	...
Gasoline, Auto, bbl.	.24	.24	.24	.24	.24	.24	...
Lard Oil, prime, gal.	1.05	1.05	1.05	1.05	1.05	1.05	...
Lead, 100 lb.	7.25	7.25	7.20	7.20	7.00	7.00	—.25
Linseed Oil, gal.	.70	.70	.70	.68	.68	.68	—.02
Open-Hearth Steel, ton	42.00	42.00	42.00	42.00	42.00	42.00	...
Petroleum, bbl., Kans., crude, gal.	1.55	1.55	1.55	1.55	1.55	1.55	...
Petroleum, bbl., Pa., crude, gal.	2.60	2.60	2.60	2.60	2.60	2.60	...
Rapeseed Oil, refined, gal.	1.05	1.05	1.05	1.05	1.05	1.05	...
Rubber, Fine Up-River, Para, lb.	.66	.65	.65	.65	.68	.66	...
Rubber, Ceylon, First Latex, lb.	.70	.70	.70	.70	.70	.70	...
Sulphuric Acid, 60 Baume, 100 lb.	3.00	3.00	3.00	3.00	3.00	3.00	...
Tin, 100 lb.	47.00	45.75	45.00	45.00	45.00	44.50	—2.50
Tire Scrap, lb.	.05¾	.05¾	.05¾	.05¾	.05¾	.05¾	...

K. C. Conditions Excellent

Crops Increased and Dealers Are Optimistic — Record Sales for 1916 Predicted

KANSAS CITY, MO., June 3—The June report of the Kansas City branch of the Federal Reserve Bank states that conditions have been extremely good in that territory and the outlook is for an unbroken continuance of prosperity. Crop conditions are excellent, there is a large increase in corn acreage, the valuable alfalfa crop is in the finest shape, stock and feeding cattle are money makers, there is a big movement of cattle from Texas and New Mexico to the Kansas and Oklahoma pastures, and altogether the situation and the prospects are highly satisfactory. "Banks have difficulty in keeping surplus funds profitably employed," the report concludes.

Automobile dealers and branch managers apparently can concur in this optimistic report. Their situation this year is far better than last year; for they have more cars to distribute.

"There can be no comparison between May, 1915, and May, 1916," said J. F. Martin, manager of the Buick Motor Co. "Our business was ten times the volume we had last year. But that was because we had the cars to deliver. Conditions are very fine in this territory, there is a good demand for cars, and I understand all the leading companies are looking forward to a record-breaking trade. The people are able to buy and pay for cars, the roads are being improved rapidly to make the use of cars even more desirable, and there seems nothing to prevent the continued expansion of the business in this district."

Electrics Gain

A. T. Clark, manager of the factory branch of the Anderson Electric Car Co., said that his company had an increase of 281 per cent in business in the Kansas City district the first 5 months of this year. There were forty-one cars sold in 1915, this period, and 164 this year. The interesting part of this record is that electric cars are going into the small towns, where previously salesmen had no idea they could sell—or it was considered hardly worth while working.

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Portage Rubber to Increase Capital $1,750,000

AKRON, OHIO, June 1—The directors of the Portage Rubber Co., Barberton, at its annual meeting on May 29, declared a quarterly dividend of 2 per cent on the common stock, the first to be paid common stockholders since the organization

of the company. The regular quarterly dividend of 1¾ per cent, will be paid on the preferred stock.

The directors adopted a resolution calling for a meeting of stockholders on July 11 to consider a proposed increase from $1,250,000 to $3,000,000 in capital stock. It is proposed that $1,500,000 of the increase be disposed of as common stock. If the increase is approved all stockholders will have the privilege of purchasing the increase in common at 105. It was announced that the company increased its business this year by 100 per cent over that of 1915.

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Packard $5,000,000 Capital Increase Authorized

DETROIT, MICH., June 3—To-day the stockholders of the Packard Motor Car Co. authorized an increase of $5,000,000 in the common stock of the concern, bringing the total capitalization to $21,000,000, of which $8,000,000 is in preferred stock.

At this meeting a new office was created, this being chairman of the board of directors, which new position will be filled by Henry B. Joy, who retires from the presidency in favor of Alvin Macauley, formerly vice-president.

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Sparton Stock for Cleveland

CLEVELAND, OHIO, June 6—Application has been made to list the stock of the Sparks-Withington Co., Jackson, Mich., on the Cleveland exchange.

Sensational Rise in Stocks

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New High Marks with Phenomenal Strength—Millions Made on Advance

NEW YORK CITY, June 7—Automobile and accessory securities on the New York Stock Exchange and the Curb Market closed on Saturday after one of the most sensational rises ever recorded in this city. Yesterday, automobile issues had a day of greatest activity and millions of dollars were passed back and forth as rumors of gigantic mergers were verified. The easily-won fortunes in the munition business have played a prominent part in the spread of automobile speculation.

General Motors Up

The Bethlehem Steel movement which carried that stock to $600 a share is outmatched in the matter of fluctuations by General Motors, which opened last week with a drop of nearly 60 points between sales, and on Saturday rose 87 points to the accompaniment of rumors of the $200,000,000 merger. Willys-Overland, the nucleus of the merger, made a new high record of 314 and closed 6 points up on the day. Other gains in the motor shares were Chandler with 11 points, and Studebaker, 3¾ points. On the curb Chevrolet sold up to the new record price of 272 and closed at 270, a net gain of 9 points.

The advances recorded for the week were as follows: Chalmers common, 30 points; Chevrolet, 20 points; General Motors, 33 points; Goodrich, 121¼ points; Packard, 15 points; Portage, 25 points; Willys-Overland, 45 points; Chandler, 18 points, and United Motor Corp., 10¾ points.

Fully 10 per cent of the whole week's dealings on the New York Stock Exchange were in motor stocks. In the Curb Market the transactions were still larger. The turnover in the brand new United Motors amounted to nearly 190,000 shares. White Motors were dealt in to the extent of nearly 90,000 and Chevrolet had a turn-over of 42,600 shares.

Many of the more conservative brokerage houses are refusing to carry the higher-priced motor stocks on margin except for customers who they know have ample means, and then only on big margins, which must be kept good.

The appreciation which has taken place in the shares of automobile, tire and accessory companies, has added hundreds of millions of dollars to the market value of these properties. Many of these concerns have been stock corporations for only a few months, and the owners who sold a controlling interest in them have in some cases seen the value of their minority holdings surpass the value of the greater interest which they sold, as appraised at the time of incorporation, less than a year ago.

Munitions Profits Factors

Bankers state that the rapid rise in automobile stocks has been due very

Automobile Securities Quotations on the New York and Detroit Exchanges

	1915 Bid	1915 Asked	1916 Bid	1916 Asked	Wk's Ch'ge
Ajax Rubber Co. (new)	..	..	68	69½	+1½
Aluminum Castings pfd	98	100	..	..	..
J. I. Case pfd	..	..	88	90	+2
Chalmers Motor Co. com	90¼	92¼	200	210	+30
Chalmers Motor Co. pfd	95	98¼	99	101	+2
Chandler Motor Car Co	..	..	120	130	+18
Chevrolet Motor Co	..	..	262	264	+20
Electric Storage Battery Co	..	..	64	66	+2
Firestone Tire & Rubber Co. com	480	485	840	860	..
Firestone Tire & Rubber Co. pfd	110	113	113	114	..
General Motors Co. com	137	138½	548	565	+33
General Motors Co. pfd	97	99	115	117	+1
B. F. Goodrich Co. com	44	45½	197	200	+121¼
B. F. Goodrich Co. pfd	101½	102	105¼	106	—9¾
Goodyear Tire & Rubber Co. com	245	248	197	200	—195
Goodyear Tire & Rubber Co. pfd	105	106	105¼	106	+¼
Grant Motor Car Co	..	..	12	13	+½
Gray & Davis, Inc., pfd	..	..	..	..	..
International Motor Co. com	14	15	10	14	..
International Motor Co. pfd	36	37	21	27	—1
Kelly-Springfield Tire Co. com	126	130	74¼	75	+2¼
Kelly-Springfield Tire Co. 1st pfd	81	83	96	98	+1
Kelly-Springfield Tire Co. 2d pfd	120	135	..	..	..
Maxwell Motor Co. com	42	43½	85¾	86	+¼
Maxwell Motor Co. 1st pfd	86	87	89¼	89¾	+¼
Maxwell Motor Co. 2d pfd	37	38	58	58½	+1
Miller Rubber Co. com	180	185	300	..	..
Miller Rubber Co. pfd	104	105	104	106	—11
New Departure Mfg. Co. com	..	..	275	..	..
New Departure Mfg. Co. pfd	..	..	112	115	—1
Packard Motor Car Co. com	102	104	240	..	+15
Packard Motor Car Co. pfd	†96¼	..	101	105	+1
Paige-Detroit Motor Car	..	..	56	..	+11
Peerless Motor & Truck Corp	..	..	25	26	—½
Perlman Rim Corp	..	..	149	152	+1
Portage Rubber Co. com	35	38	110	113	+25
Portage Rubber Co. pfd	85	88	112	114	+4½
Regal Motor Co. pfd	..	..	22	..	+2
*Reo Motor Truck Co	15	16¼	37	37½	—1
*Reo Motor Car Co	32¾	33¾	44½	45	+2½
Saxon Motor Car Co	..	..	81	83	—2
Splitdorf Electric Co. pfd	..	..	..	..	..
Standard Motor Co	..	..	8	8½	..
Stewart-Warner Speed. Corp. com	65½	66½	86	90	—2½
Stewart-Warner Speed. Corp. pfd	103	105	108	110	—1
Studebaker Corp. com	65	67	141½	142½	+4½
Studebaker Corp. pfd	97½	100	108	112	+1
Swinehart Tire & Rubber Co	80	90	83	84	..
Texas Co	..	..	190	192	—2
United Motor Corp	..	..	88¾	89	+10¾
U. S. Rubber Co. com	62	63½	55¾	56¼	+½
U. S. Rubber Co. pfd	106	107	109½	110	+½
Vacuum Oil Co	..	..	248	253	—1
White Motor Co. (new)	..	..	57⅜	58⅛	+7⅜
Willys-Overland Co. com	114	116	310	320	+45
Willys-Overland Co. pfd	99½	101	111	112	+5

OFFICIAL QUOTATIONS OF THE DETROIT STOCK EXCHANGE

ACTIVE STOCKS

	1915 Bid	1915 Asked	1916 Bid	1916 Asked	Wk's Ch'ge
Auto Body Co	..	..	35½	..	+1
Chalmers Motor Co. com	..	92	210	230	+31
Chalmers Motor Co. pfd	95	98	96	100	..
Continental Motor Co. com	180	200	37¼	38¼	—½
Continental Motor Co. pfd	84½	86	9¾	10⅛	—¼
Ford Motor Co. of Canada	950	..	..	405	..
General Motors Co. com	146	150	470	525	+40
General Motors Co. pfd	99	100	115	118	..
Maxwell Motor Co. com	43	46	84	86½	—½
Maxwell Motor Co. 1st pfd	86	88	88	91	—½
Maxwell Motor Co. 2d pfd	38	40	56	58½	—1½
Packard Motor Car Co. com	102	104	240	..	+10
Packard Motor Car Co. pfd	96¼	..	101	104	..
Paige-Detroit Motor Car Co	..	..	55½	56¾	+½
*W. K. Prudden Co	19½	21	40	45	..
*Reo Motor Car Co	32½	33½	44½	45½	+2½
*Reo Motor Truck Co	14⅝	15½	36¾	..	—¾
Studebaker Corp. com	67	69	139	141½	+2½
Studebaker Corp. pfd	..	100	110	..	..

INACTIVE STOCKS

*Atlas Drop Forge Co	..	26	..	40	..
Kelsey Wheel Co	200	..	..	350	..
Regal Motor Car Co. pfd	..	25	17	..	..

*Par value, $10. †Ex dividend.

largely to the prosperity enjoyed by persons engaged in the manufacture of automobiles or in allied industries and to the immense sums for investment accumulated by the owners of companies engaged in the munitions business.

The following table listing a number of the companies whose stocks have been particularly active during the past week, shows the large appreciation caused by the wild speculation. All of the issues are new, with the exception of Willys-Overland and General Motors and in these issues the price of a year ago is used:

Company	Issued at	Yesterday's High	Appreciation
General Motors	150	560	$66,400,000
Willys-Overland	130	325	40,950,000
Chandler	85	131	3,220,000
Lee Tire	50	56½	650,000
Chevrolet	85	278	154,400,000
United Motors	62	94	38,400,000
Perlman Rim	120	162½	4,250,000
White	51	60	2,880,000
Total advance			$311,240,000

Dividends Declared

Rubber Goods Mfg. Co.; quarterly of 1¾ per cent on preferred, payable June 15 to stock of record of June 9.

Kelly-Springfield Tire Co., quarterly of 1½ per cent on preferred, payable July 1 to stock of record June 17.

Yale & Towne Mfg. Co., quarterly of 1¾ per cent, payable July 1 to stock of record June 23, and an extra dividend of 10 per cent, payable June 7 to stock of record May 31.

$20,000 Prize Money for Twin City Meet

MINNEAPOLIS, Minn., June 5—With $20,000 in cash prizes, four races are open to professionals on the Twin City Speedway for July 4. The Mid-Continent races are for 150 miles, 50, 20 and 10 miles. For the first race seven prizes are hung up ranging from $6,000 to $400. For the second are five prizes from $1,000 to $200, and for the third five prizes from $600 to $100. The final race is a consolation handicap for non-winners. First prize is $400, second is $200, third is $175 and fourth is $125 and fifth $100.

Correction

In THE AUTOMOBILE for Jan. 27, 1916, an article was published entitled Working Out the Rolls-Royce Brake. We have just been informed by the Rolls-Royce company that the experiments therein described were not conducted by any member of its staff. In justice to the author it should be explained that the mistake was due to no fault of his but a confusion between his name and that of a recent member of the Rolls-Royce engineering force.

Oldfield Sets Record for 2 Miles

Drives Front-Drive Christie Racer at 113 M.P.H. on Chicago Speedway

CHICAGO, ILL., June 5—Barney Oldfield, driving his front-drive Christie car, established a new American speedway record for 2 miles on the Chicago speedway here to-day, averaging 113 m.p.h. in an unsuccessful attempt to break the world's record for the distance. The best previous American speedway record for the distance was that made by Caleb Bragg in a Fiat on the Los Angeles 1-mile speedway April 13, 1910, in 1:15.96, or at 95 m.p.h.

Harkness Delage Team and Peusun Out of Chicago Race

CHICAGO, ILL., June 2—The Harry Harkness racing team, composed of the Delage cars and the Peusun, will not race at Chicago. They are being shipped to New York City instead and will be rebuilt. The cars are top heavy for track work as they have the gasoline too high. The tails will be taken off and the tanks underslung. Another fault in the cars is in the baffling of the gasoline. There is only one baffle plate in the tanks and the gasoline has a tendency to rush to the outside under the influence of centrifugal force, on the curves. The result is that the cars are not suited for track work.

It is expected, according to Gaston Morris, who is traveling with the team in an advisory capacity and who is well known for his track generalship, that the cars will be ready for Minneapolis.

Studebaker Convention Opens

DETROIT, MICH., June 3—More than fifty branch managers and assistant branch managers of the Studebaker Corp. reached Detroit this week for the convention which is scheduled to be in session from June 6 to June 9. They came from all parts of the country, as far East as Boston and as far West as San Francisco.

Daily meetings are on the program to be held at the Studebaker factory, at which L. J. Ollier, vice-president and director of sales, will preside. A. R. Erskine, president of the corporation, came over from South Bend, to be present throughout the week. Talks by heads of the sales, service, engineering and production departments, along with inspections of the factories, will complete the business session.

One of the events of the program will be a view of the factory improvements which were announced at the last convention in December and have since become a reality. These improvements have been made with a view to increasing the production of Studebaker cars, making possible an output of 100,000 cars.

Reports from the branch managers and retail sales managers on conditions in their territories are expected to furnish a good gage on the prospects for the remainder of the year. Among the branch managers who attended are F. R. Bump, New York; Henri Neubauer, Philadelphia; G. N. Jordan, Boston; A. H. Pearsall, Chicago; L. B. Alford, Dallas; W. S. Williams, Kansas City; R. D. Maxwell, Los Angeles; E. R. Carpenter, San Francisco; J. A. Graham, Minneapolis; R. H. Williams, Detroit; L. A. Keller, Omaha; L. S. Weeks, Atlanta; A. H. Brown, Portland, Ore.; C. J. Simons, St. Louis; T. W. Naylor, Salt Lake City; J. B. Renshaw, South Bend. The following district managers are also in attendance: J. O. Hahn, Cleveland; E. W. Gans, Indianapolis; J. A. Haskell, Des Moines.

C. A. C. Calls for Cars

CHICAGO, ILL., June 6—The National Committee of Home Defense motorists have appointed a committee from the members of the Chicago Automobile Club headed by Joseph E. Callender as chairman to organize a motor reserve corps in Chicago. As its initial effort this committee will transport the First Infantry of the Illinois National guards to their annual camp at Fort Sheridan and to do this the services of 200 touring cars and fifteen trucks will be required.

King Establishes New York Branch

NEW YORK CITY, June 2—The King Motor Car Co., Detroit, Mich., has bought out the King holdings of the A. Elliott Ranney Co., this city, and is now managing the sale of the King Eight at Broadway and Fifty-second Street. At the present time the business is being handled by factory representatives under the direction of Joseph Porter. The service department will be located at 250 West Fifty-fourth Street.

Christiaens Used Rajah Plugs

NEW YORK CITY, June 6—Joseph Christiaens, whose Sunbeam car finished fourth in the Indianapolis 300-mile race last week, used standard Rajah spark plugs. Eight out of the ten cars to finish the race were equipped with Rajah plugs.

Lexington Speedway Co. Formed

LEXINGTON, Ky., June 2—The Lexington Speedway Co., this city, has been organized for the purpose of building a $300,000 automobile speedway. The incorporators are J. T. McKee, Rosedale, Ky., and G. M. McCarthy, Louisville.

Question Benefit of Ga. Law

State Finds Owners Are Not Paying Ad Valorem Tax—33,840 Cars Registered

SAVANNAH, GA., June 2—Whether the several counties of the State get any more out of the new automobile law or not, there are more automobiles registered this year in Georgia than last by about 33 1/3 per cent. The manner in which the statistics will be compiled under the new law will, too, show exactly how many automobile owners in just what counties are not returning their cars to the county for ad valorem taxation—and exactly who they are.

A Gain of 11,630 Cars

At the opening of business in the office of the Secretary of State on the first day of May, 1915, the last automobile registered was 22,210. The 1916 record for the same date shows that the last number sold was 33,840, or 11,630 more cars registered up to the close of business on the last day of April this year than last year. After the first of May last year there were approximately 3000 more cars registered, and secretary Cook believes the final registration this year will add 5000 to 6000 more cars to the 1916 list.

States Loses $30,698 on Fords

On Ford cars alone the State has, this year, lost $30,698, as compared to the return on the same number of Ford cars under the fixed fee of the old law. Heretofore a State tag cost as much for a car of that class as for any other, $5, while under the new law that class of automobiles has been graded down, the present fee being $3, and the list shows that there are 15,349 Ford automobiles registered in Georgia this year. There are 237 pleasure electric and 1140 delivery wagons and motor trucks registered. In both the latter class, however, it is evident that added registrations will have to be made, since there are more of both classes in operation in the State than the record shows.

The New Law

The new law provides that, on or before May 1, the board of commissioners in each county of the State shall report to the Secretary of State the official number of miles of public roads in the county, outside the incorporated cities and towns, the correct number of motor vehicles returned for taxation in the county in 1915, as shown by the county tax books, and certify that 90 per cent. of the motor vehicles owned in the county have complied with the State law requiring registration in the office of the Secretary of State, and have 1916 license numbers attached to their cars. On the basis of this report the Secretary of State apportions the fund derived from the sale of 1916 license tags among the several counties, provided they have complied with the 90 per cent. registration and other features of the new law.

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New York State to Tax Motor Vehicles on Road Wear

ALBANY, N. Y., June 1—All owners of automobiles and motor trucks will have to pay additional fees to the State within a year because of the wear and tear of the vehicles on the highways. Governor Whitman has signed the Hewitt bill providing for the levy of the fees by Feb. 1, next year.

The Hewitt bill directs the commissioner of highway, superintendent of public works and the State engineer to adopt a schedule of fees for the registration of omnibuses that carry passengers and trucks for the transportation of freight. They are to classify the vehicles upon the basis of time and extent of use upon the highways relative to the wear and tear of the roads. The schedule is to be turned over to the Secretary of State by the first of next year.

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Lift Massachusetts Blue-Law Ban

SPRINGFIELD, Mass., June 4—Motorists in this city in particular and throughout Massachusetts in general are breathing easier, and so are the garage men as a result of Chief of Police William J. Quity delving more deeply into the law of Sunday sales. He had notified the garage men that the sale of gasoline was illegal on Sunday. There had been a prosecution, and as the Legislature had refused to make a change in the law there seemed to be a deadlock with the prospect of the trouble spreading throughout the State. Then some of the automobile officials got busy and claimed that as gasoline is derived from gas, and the latter can be sold on Sunday, gasoline could be retailed.

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Safety First Society Urges New Rules

NEW YORK CITY, June 2—At a meeting, yesterday, before the General Welfare Committee of the Aldermen, this city, four ordinances in the interests of Safety First, were proposed by the Safety First Society of New York. The meeting was also attended by members of the Automobile Dealers' Assn. and the Police Department. The proposed ordinances introduced were: To guard unprotected side chains on motor vehicles; to prevent trespassing upon or hitching on motor vehicles and wagons; to safeguard properly motor vehicles when left unattended in the streets; and to eliminate the glare of automobile headlights.

Tractor Engineers Convene

Problems of Growing Industry Discussed at Session in Minneapolis, Minn.

MINNEAPOLIS, MINN., June 2—The Society of Tractor Engineers met May 29 at the Andrews in convention.

Two papers were read. C. D. Meyers of the Timken-David Brown Co. discussed "Worm Gearing and Its Application to Tractors." The Ford Tractor Co. has applied the gear and other companies are reported adopting or considering the application of the same gear. Meyers discussed this in a technical way.

Haulage a New Field

A. W. Scarrett of the Minneapolis Steel & Machinery Co. read a paper on "Tractor Haulage." This is a comparatively new field, and the limitations and advantages of the tractor for this work were ventilated. The speaker used charts and statistics to show what disadvantage to the tractor in road work is even a light grade and bad conditions of the track.

Robert Gaylord of the Gray Tractor Mfg. Co., secretary of the society, said that the whole field of tractor discussion is a new one and is capable of indefinite development and discussion. In particular the question of tractor haulage is capable of infinite elaboration and study. He said Minneapolis is now the greatest tractor city in the country and that the society is therefore growing rapidly.

Plan National Extension

Plans for national extension are working out, and any tractor engineer, tractor factory firm or accessory manufacturer in the tractor line is eligible for membership.

Officers of the new organization are: President, G. T. Strite; vice-president, W. J. McVicker; secretary-treasurer, Robert Gaylord; additional directors, H. A. Buffington, C. C. Cavanaugh, G. C. Andrews and O. B. Kinnard.

To become a national organization is the purpose of the society. The local association has fifty members, which is a rapid gain from a modest start last winter.

Patterned After S. A. E.

It was announced at the meeting that the society is for tractor engineers and tractor firms, with an associate membership for manufacturers of tractor accessories. It is patterned after the S. A. E. on a smaller scale.

Outside memberships are coming in rapidly and it is probable societies will be organized in other large tractor centers.

Ideal Wheel Plant in Massillon—The Ideal Wheel Co. has planned to construct a factory in Massillon, Ohio. The company recently increased its capital from $50,000 to $150,000.

Kressler to Add—The Kressler Auto Co. is planning the construction of a two-story, 100 by 200-ft. addition to its plant at Fostoria, Ohio.

Kankakee Welding to Reconstruct Plant—The Kankakee Universal Welding Co., maker of wire wheels for automobiles, will reconstruct its plant at St. Anne, Ill., which was recently destroyed by fire with a loss of $100,000.

J and D Tire to Build—The contract has been awarded for the construction of a factory for the J and D Tire and Rubber Co., Charlotte, N. C., at an estimated cost of $500,000.

To Build Motors—The Davies-Mitchell Engineering Co., 220 Union Bldg., Cleveland, Ohio, has been organized to build six- and twelve-cylinder automobile motors and expects to begin the erection of a plant in about 90 days.

Limousine Top Acquires Bldg.—The Limousine Top Co., Kalamazoo, Mich., maker of automobile tops, has acquired an additional building and will increase its output considerably.

To Make Bodies in Savannah—F. C. Kramer of Savannah, Ga., will shortly begin the erection of a factory, 150 by 200 ft., of steel and reinforced concrete, for the manufacture of bodies for commercial automobiles, automobile wheels, etc. The equipment has been bought and will have a daily capacity of 600 wheels from 24 to 28 in. in diameter. A site has been purchased on Dale Avenue and it is expected that the plant will be ready for operation April 1, 1917.

To Make Parts—The Lawndale Mfg. Co., Elkhart, Ind., has been formed with a capital of $75,000 and has secured factory space in which equipment is being installed for the manufacture of automobile parts. A. H. Beardsley, W. H. Foster and J. A. Bell are the directors.

Newark Stamping Adds—The Newark Stamping & Foundry Co., Newark, Ohio, has let a contract for a second addition to plant No. 2, foundry department. This is the second addition since Feb. 1. The company manufactures gray iron castings, brass or aluminum. The stamping department is working nights making the Thompson hose clamps.

Ogren Adds—The Ogren Motor Car Co., Chicago, Ill., is constructing a three-story mill on Sacramento Boulevard, between Chicago and Grand Avenues, at an estimated cost of $85,000.

Jeffery to Add—The Thomas B. Jeffery Co. has awarded the contract for the construction of a foundry and manufacturing building at Kenosha, Wis.

Akron Tire Co. Acquires Site—The Punctureless Auto Tire Co., Akron, Ohio, has acquired a site in Barberton on which it will erect a plant, 60 by 400 ft., and a powerhouse.

Detroit Heating Co. to Add—The Detroit Heating & Lighting Co., Detroit, Mich., maker of sheet-metal specialties for automobiles, has completed plans for the erection of additional buildings to double its present capacity.

Wadsworth Body to Build—Plans have been prepared for the construction of a two-story, 95 by 350-ft. factory in Detroit, Mich., for the Wadsworth Mfg. Co., maker of automobile bodies. The estimated cost is $60,000.

Double Service Tire for Barberton—The Double Service Tire and Rubber Co., Akron, Ohio, is coming to Barberton. The company has bought 4 acres of land and work has been started on the new buildings.

General Tire Adds—The General Tire & Rubber Co. is building a large addition to its plant in Akron, Ohio. The company was formerly the Western Tire & Rubber Co., Kansas City, Mo.

The Automobile Calendar

ASSOCIATIONS

June 12-16—S. A. E. Summer Trip on Great Lakes.
July 2-6—Detroit, Mich., World's Salesmanship Congress, Detroit Board of Commerce Bldg.
Dec. 2-9—Electricians' Country-wide Celebration.

CONTESTS

June 10 — Chicago Speedway Race. International 300-Mile Race, Speedway Park, Speedway Park Association.
June 17—Newark, N. J., Track Race, Olympia Park, Auto Racing Assn.
June 20—Galesburg, Ill., Track Race, 100 miles.
June 22-23—Chicago, Interclub Reliability Run, Chicago Automobile Club.
June 26—Des Moines, Iowa, Speedway Race, Price Speedway Co.
June 28 — Des Moines, Iowa, Speedway Free-for-All, 300-Mile Race.
July—LaGrande, Ore., Track Race, LaGrande Motor Club.
July 4—Coeur d'Alene, Idaho, Race Meet, Hiller-Riegel Co.
July 4—Tacoma, Wash., Speedway Race, Tacoma Speedway Assn.
July 4—Minneapolis 300-Mile Speedway Race.
July 4—Sioux City Speedway Race.
July 4—Newark, N. J., Track Race, Olympic Park, Auto Racing Assn.
July 4—Visalia, Cal., Road Race, Tulare Co. Auto Club.
July 4—Spokane, Coeur D'Alene, Track Race, Reigel-Hiller Co.
July 4—Benton Harbor, Mich., Track Race, F. E. Fitzsimmons.
July 4—Elmira, N. Y., Track Race, Elmira Auto and Motorcycle Racing Assn.
July — Burlington, Iowa, 100-Mile Track Race, Tri-State Fair.
July 15—Portland, Ore., Track Race, Northwest Auto Assn.
July 15—Omaha, Neb., Speedway Race.
July 15—North Yakima, Wash., Track Race, Hiller-Riegel Co.
Aug. 5—Tacoma Speedway Race, Tacoma Speedway Association.
Aug. 11-12—Pikes Peak, Col., Hill Climb, Pikes Peak Auto Highway Co.
Aug. 12—Portland, Ore., Track Race, Hiller-Riegel Co.
Aug. 18-19—Elgin Road Race, Chicago Auto Club.
Aug. 26—Kalamazoo, Mich., 100-Mile Track Race.
Sept. 1-2—New York, N. Y., Sheepshead Bay Speedway, 24-Hour Race, Trade Racing Assn.
Sept. 4—Elmira, N. Y., Track Race, Elmira Auto and Motorcycle Racing Assn.
Sept. 4—Cincinnati, Ohio, Speedway, Cincinnati Speedway Co.
Sept. 4—Newark, N. J., Track Race, Olympic Park, Racing Assn.
Sept. 4—Indianapolis Speedway Race.
Sept. 4—Des Moines Speedway Invitation Race. Limited to six entries.
Sept. 4-5 — Spokane, Wash., Track Race, Inland Auto Assn.
Sept. 16—Providence Speedway Race.
Sept. 18—North Yakima, Wash., Track Race, Washington State Fair.
Sept. 29—Trenton, N. J., Inter-State Fair. H. P. Murphy, Racing Sec.
Sept. 30 — New York City, Sheepshead Bay Speedway Race.
Oct. 7—Philadelphia Speedway Race.
Oct. 7—Omaha Speedway Race.
Oct. 14 — Chicago Speedway Race.
Oct. 19—Indianapolis Ind., Race, Indianapolis Motor Speedway.
Oct. 21 — Kalamazoo, Mich., Track Races, Kalamazoo, Motor Speedway.
Nov. 16 and 18—Santa Monica, Cal., Vanderbilt Cup and Grand Prix Races.

GOOD ROADS

Sept. 6-7—St. Paul, Minn., Good Roads Congress, Auditorium.

MISCELLANEOUS

June 8—New York City, Orphans' Day Outing at Donnelly's Grove, College Point, L. I. Orphans' Automobile Day Outing Assn.

SHOWS

Sept. 2-9—Columbus, Ohio, Fall Show, Ohio State Fair, Columbus Automobile Show Co.

TRACTOR

July 17-21—Dallas, Tex., Tractor Demonstration.
July 24-28—Hutchinson, Kan., Tractor Demonstration.
July 31-Aug. 4—St. Louis, Mo., Tractor Demonstration.
Aug. 7-11—Fremont, Neb., Tractor Demonstration.
Aug. 14-18—Cedar Rapids, Iowa, Tractor Demonstration.
Aug. 21-25—Bloomington, Ill., Tractor Demonstration.
Aug. 28-Sept. 1—Indiana Tractor Demonstration.
Sept. 4-8—Madison, Wis., Tractor Demonstration.
Sept. 11-16 — Milwaukee, Wis., Fall Show, Wisconsin State Fair. Milwaukee Automobile Dealers.

The Week in the Industry

Trade Happenings

Oregon Items—The Scripps-Booth line will hereafter be distributed in Portland and throughout Oregon by the Braly Auto Co. Coincident with this announcement is the news that H. W. Lyons has returned to the Braly Auto Co. as sales manager.

The Oregon Oakland Motor Car Co. has been named representative for the Vim truck in Portland and vicinity.

Washington Items—Turnley & Rathke, Rosalia, have contracted to handle the Oakland line in that territory.

The Traders Tire & Motor Suppy Co., Spokane, has been appointed distributor for eastern Washington and part of Idaho for Smith Form-a-truck.

The Washington Automobile Chamber of Commerce at a recent meeting in Seattle perfected a plan of organization for automobile dealers in all the cities and counties of the Northwest.

To Make Automobile Sleepers—The Bradley Manufacturing Co. has recently been incorporated in Tacoma, Wash., to produce a folding berth or automobile sleeper that can be quickly adjusted to any model of automobile, and used for sleeping quarters.

The bed can be adjusted in from 3 to 5 min. and weighs only 30 lb. It folds up so it can be conveniently placed on the running board of an automobile.

A three-story building near Tacoma will house the new manufacturing plant, and the automobile beds will be shipped to all parts of the world.

Philadelphia Tire Co. Opens Branch—Carrier & Harlan, Philadelphia, Pa., have opened a branch store in West Philadelphia at 3322 Chestnut Street under the supervision of C. W. Glose. The Philadelphia store is at 263 N. Fifteenth Street. They specialize in repairing and vulcanizing and also carry U. S. tires and other automobile accessories.

Changes in San Diego, Cal.—San Diego's automobile row has shifted to lower Broadway. During the past week automobile houses have sprung up like mushrooms on the busy street.

The first Broadway automobile house was the Pacific Kissel Kar branch which opened up in a location at Broadway and Union Street. Then F. B. Naylor, Buick distributor, moved into the new Naylor building directly across the street.

A few days later, the San Diego Motor Co. opened up on the corner of Broadway and State Street, with the agency for the Chevrolet. This move was followed by the opening of a tire store on one corner by a firm operating under the name of Higgins & Shaw, and the Pacific Auto Sales Co. on another corner. The Pacific Auto Sales Co. has the San Diego agency for the National, Oldsmobile and Oakland, and the new location is one of the finest corners of the many new automobile houses erected in San Diego during the past few months.

Mead Cornell and Ed. Caley then opened a tire store at 311 Broadway, next to the Pacific Kissel Kar branch and the Paige and Peerless agency moved into a location three doors south. There are more to come; and all the places on Broadway are about as attractive as any in California. The Mitchell agent is erecting a new garage, and Green & Fleming, Chandler and Grant dealers, are soon to occupy their new home.

New York City Items—The Hudson Motor Car Co., New York City, has just opened its new six-story service building at 243-249 West Sixty-seventh Street. The building contains more than 60,000 sq. ft., is fireproof, and the exterior is of white glazed brick and terra cotta. At the present time there are about 3500 Hudson cars in this territory. The Hudson Sales Co., in Philadelphia, Pa., will also have a new service station and salesroom. This building will be a two-story brick structure, 22 by 66 ft.

The Ford Motor Co. has purchased a site for a salesroom on the northeast corner of Fifty-fourth Street and Broadway, adjoining the Hotel Woodward. The property, which brought close to $600,000, is 129.6 by 54.7 ft. on Fifty-fourth Street, and has a depth of 86.8 ft. on the northerly line adjoining the Hotel Woodward. The present buildings will be replaced by a sixteen-story structure.

J. C. Nichols, factory distributor for the Compensating Vapor Plug, is placing extra orders for the device. Since the plug was introduced last January more than 600,000 have been sold.

Stevens & Co., 375 Broadway, have introduced an automatic blow cock and cleaner for garages and machine shops. It is used in connection with the air service system, and is convenient for dusting out cars, cleaning engines, etc. The valve is furnished with a ground-in metal-to-metal seat.

Charles E. Reiss & Co., handling the Stearns-Knight and Hupmobile, have opened a service department at 226-234 West Fifty-sixth Street. This will occupy the entire top floor of the building.

Longenecker & Sanders, handling the Abbott-Detroit, have inaugurated a service department at 245-247 West Fifty-fifth Street.

Scharps Promoted—C. E. T. Scharps, who recently joined the C. T. Silver Motor Co., New York City, as advertising manager and assistant to Mr. Silver, has been promoted to the position of manager of the Newark, N. J., branch. Mr. Silver, who handles the Overland, Willys-Knight and Peerless business in this territory, has also made G. Franklin Bailey director of branches. W. E. White has been put in charge of the service department.

New Agencies for Braender Tires—The following new agencies are reported by the Braender Rubber & Tire Co., Rutherford, N. J., manufacturer of Braender tires and tubes: American Motor & Equipment Co., 181 Massachusetts Avenue, Boston, Mass.; The Kassler Motor Co., Fifth and White Streets, Dubuque, Iowa, and H. B. Herr, 30 West King Street, Lancaster, Pa.

Mountain Trade—C. V. Swenson, proprietor of the East End Garage, 2325 Larimer Street, Denver, has secured the Colorado and Wyoming distributing agency for the Republic Truck, and has opened a salesroom in a central location at 1940 Champa Street, opposite the new Federal and Postoffice Building. A service station is maintained at both the garage and the downtown salesroom.

The Wm. Thorney Auto Co., Apperson distributor for Colorado and Wyoming, has moved from 1443 Cleveland Place, Denver, to 1133 Broadway.

Cassell Brothers Music Co., 205 Sixteenth Street, Denver, has secured the Abbott-Detroit distributing agency for Colorado and Wyoming, and has remodeled its piano business quarters by adding an automobile salesroom around the corner to front on 1607 Broadway.

The Plains Automobile Co., 1605-1607 Central Avenue, Cheyenne, Wyo., Buick and Packard agency, has been sold by H. A. Andrews to F. H. Gleason.

The Colorado Motor Car Co., 1520 Broadway, Denver, Saxon, Reo and Cole distributor for Colorado and Wyoming, has taken the Hesse Trailer distributing agency for the same territory.

The Chalmers Exchange is the name of a new concern at 1443 Cleveland Place, Denver, which handles used cars traded in upon Chalmers sales, and also operates a garage and service station.

James A. Nisbet, 1551 Broadway, Denver, Scripps-Booth distributer for Colorado and Wyoming, has secured the Glide distributing agency for the same territory.

Mulnix & Rarie, East Colfax Avenue and Lincoln Street, Denver, Grant and Pathfinder distributors for Colorado and Wyoming, have secured the distributing agency for the Atterbury truck for the same territory.

D. S. Eddins, recently Rocky Mountain district supervisor for the Maxwell, with headquarters in Denver, has been transferred to the Detroit district, where he is special traveling representative.

The Rocky Mountain Motor Co., a new Denver concern, has secured the Case distributing agency for Colorado, Wyoming and New Mexico, and is remodeling its quarters at 1635 Broadway to provide a car salesroom.

De War Brothers, Denver, have bought Earle H. Frazier's garage at 741-747 Broadway, and have taken over the Detroit Electric agency for Denver and vicinity.

The B. F. Goodrich Rubber Co.'s Denver branch, 1422-1424 Court Place, is now in charge of C. A. Cotter, formerly chief adjuster at the St. Louis branch. H. E. White, whom Cotter succeeds as manager, has been transferred to a factory position. J. K. Laird, formerly Kansas City adjuster, is the new assistant manager of the Denver branch, and C. L. Harding is new chief clerk.

The Philadelphia Storage Battery Co. has closed its Denver factory branch at 1435 Cleveland Place, and the business for this territory has been taken over on an agency basis by De War Brothers, 741-747 Broadway.

New England Trade Items—An agency for the Elkar line has been placed in Boston with the Paine-Krogman Company, Commonwealth Avenue.

F. S. Brewer, Springfield, Mass., has taken the agency for Empire cars for central Massachusetts.

An agency for Pullman cars has been placed with Mosher & Fimbell, Springfield, Mass.

The Elite Garage, New Haven, Conn., has taken on the Halliday line.

M. H. Chase, Owen Magnetic dealer at Boston, has leased 20,000 sq. ft. in a new service building in that city.

The Crane & Bratish Motor Co., Providence, R. I., has been dissolved and the garage it conducted sold to A. J. Howard, agent for Scripps-Booth.

A. S. Holley, formerly manager of the New England branch of the R. E. Taylor Corporation, Garford dealer, has accepted a position as retail sales manager for the New England agency for Jackson cars.

Firestone Factory Branch in Springfield—The Firestone Tire & Rubber Co. has established a factory branch at Springfield, Mass., with headquarters at 44-50 Hillman Street. It is in charge of G. I. Engle and he will direct Firestone sales in Vermont, southwestern New Hampshire, northern Connecticut and central and western Massachusetts. The local agency for the tires will still remain with F. N. Sauers.

Columbus Items—A. J. Adams, formerly an engineer with the General Electric Co., has opened a repair shop at Lafayette and Lazell Streets under the name of the Adams Auto-Electric Service Co. He will specialize on the repair of electric systems on automobiles.

The Dixie Flyer Sales Co. has been organized at State and Front Streets to handle the Dixie Flyer in central Ohio territory.

The Ohio Auto Brass Co. has removed from 27 West Russell Street to larger quarters at 36 and 38 West Swan Street.

The Overland Agency in Columbus was taken over June 1 by Willys-Overland, Inc. The agency was held by the O. G. Roberts Co. for about 6 years. The service station of the branch will remain at 933 East Gay Street, while the salesrooms will be moved down town in automobile row, located at Gay and Fourth Streets. C. T. Dunkle is Columbus branch manager.

The Brashner Motor Car Co. has been moved from Fourth and Gay Streets to 167 North Fourth Street. It handles the Studebaker in central territory.

Connecticut News—S. A. Miner, Hartford, distributor of Pierce-Arrow cars in northern Connecticut, has opened a new service station on Spruce Street. The building is of steel and brick one story high and fully equipped. The floor space is nearly 100 ft. square.

E. C. Andrews, Hartford, formerly of the Overland-Hartford Co., in the wholesale department has accepted a position as Connecticut district manager of the Chevrolet Motor Co., Inc.

The Williams sales stables, Hartford, have been torn down to make way for a new building to be erected by W. W. Walker which is to adjoin the service and sales building of R. P. Taber, Reo distributor, now in course of construction.

The R. D. Britton Co., Hartford, Conn., has doubled its salesroom capacity by utilizing the west side of the garage proper. The change gives the concern one of the very largest show rooms in the city.

E. H. Harris, Hartford, treasurer of the Charter Oak Motor Car Co., Chandler and Hupmobile distributor, has acquired the old local factory of the National Biscuit Co., at 99-103 Albany Avenue. Upward of $100,000 will be expended in the improvement of the property. The building will be remodeled and the main floor will be dropped to the street level and will be changed to accommodate two stores. A modern service station will be provided in the course of alterations. This acquisition adjoins property owned by Mr. Harris.

News from the S. W.—The Lexington K. C. Co., Kansas City, Mo., has moved from 1729 McGee Street to 1924 Grand Avenue.

The Ramsey Auto Co., Kansas City, Mo., has taken the agency for Western Missouri and Kansas of the Detroiter Six.

Roy and Elmer Chamberlain, Smith Center, Kan., have bought the garage of Will Bell, and taken his agency for the Maxwell and Overland in that section of the State.

The Shawnee Motor Co., Topeka, Kan., has the North Topeka agency for the Overland.

The H. A. Dougherty Motor Co., Kansas City, Mo., distributor of the Republic truck and the Smith Form-a-Truck truck of Chicago, will soon be established in its new quarters at 1701 to 1707 McGee Street. It has a new brick and concrete building 105 by 122; on the McGee Street frontage is a display room and the offices, 50 by 105 ft. In the rear is the service department and a parts department. The basement is also to be used for shops, with complete equipment for gear cutting, in fact, equipment with which an entire automobile could be built. There are numerous skylights serving the first floor. A private garage is entered from Seventeenth Street, for the automobiles of the heads of departments. Across Seventeenth Street a two-story building 100 by 100 has been leased for storage and paint shop. The company retains its former quarters, 1808-10 Grand Avenue, for a body factory, and machinery for woodworking is being installed there. Mr. Dougherty was for 7 years manager of the Overland company at Kansas City. H. M. Genung, manager of the Dougherty company, was also with the Overland before the branch was established in Kansas City.

Edwards & Standish, Larned, Kan., are opening a new salesroom which will be the headquarters for the Inter-State.

J. T. Tough & Son, Metz, Mo., have bought a garage at Mound City, Mo., and have taken the Ford agency.

Charles Scherrer, Admiral and Independence boulevards, Kansas City, Mo., are now agents for the New Era.

The Buick Garage, Sweet Springs, Mo., will henceforth be operated by John Eckhoff and his son Harry, Mr. Eckhoff having bought the interest of his partner, Des Haggard.

Lester Cadman and Mr. T. Bird, Joplin, Mo., have been transferred to the Kansas City branch of the United States Tire Co., the Joplin branch having been discontinued.